PRELIMINARY DRAFT
SUBJECT TO CHANGE

FEASIBILITY STUDY FOR A LIGHT RAIL ALIGNMENT

BI STATE

Bi-State Development Agency

INTRODUCTION

Background

Planning for a St. Louis rail transit system dates back to a 1971 study recommending implementation of a 100-mile rapid rail transit system. Construction costs for this system were estimated at $2 billion in 1974, rising rapidly with each year of delay. The East-West Gateway Coordinating Council (EWGCC), the area's regional council of governments, rejected the system, primarily due to its lack of cost-effectiveness and public support.

EWGCC then undertook a study of mass transit alternatives, an UMTA Phase I Alternatives Analysis. First, this study was a prerequisite to federal funding of any system, and second, EWGCC hoped that the study would find a less costly way to fill the area's mass transportation needs. The recommended plan was indeed a less costly system, consisting of a light rail/freeway bus system billed at $490.7 million. EWGCC adopted the plan, but faced with the necessity of committing additional planning funds to complete Phase II of the Alternatives Analysis, tried to secure a commitment from the Urban Mass Transportation Administration (UMTA) to fund the resulting system. When this commitment was not forthcoming, EWGCC retracted its adoption and voted to continue developing an all-bus system.

Subsequently gasoline shortages and rapidly rising gasoline prices generated renewed interest in rail transit for St. Louis. Supporters of a rail transit system urged the Bi-State Development Agency to fund a "feasibility study" of light rail transit.

Bi-State in November 1979 contracted with Daniel, Mann, Johnson, and Mendenhall (DMJM) to conduct a feasibility study to determine the cost and benefits of constructing a light rail system along the N & W railroad right-of-way from East St. Louis, through downtown St. Louis, to the McDonnell/Douglas, Lambert Field, and Brown Campus area of St. Louis County, the most promising transit corridor according to previous studies. In May 1980 the contract was amended to incorporate an alternate alignment which appeared initially to offer fewer engineering problems and greater patronage potential.

Study Objectives

Basically the study was designed to determine the feasibility of constructing a light rail transit system using, where possible, railroad rights-of-way. Specific study tasks include:

1. Define Objectives of Proposed Light Rail Line
2. Analyze and Refine Alignment
3. Analyze Transit Demand
4. Analyze the Existing Bus System
5. Develop Preliminary System Costs & Revenues
6. Develop Financial Plan
7. Conduct Cost/Benefit Assessment
8. Conduct Community Interaction Plan
9. Prepare Reports

Two aspects of the study are especially important. First, the consultant, working closely with affected railroad companies, conducted an analysis of the proposed alignment to determine significant engineering problems along the proposed alignment.

The goal was to integrate the light rail system into existing railroad rights-of-way to the maximum extent possible, without adversely affecting railroad freight operations. Railroad companies, especially N & W and TRRA, were very cooperative, and provided valuable assistance to the consultant.

Another significant component of the study involved an analysis of urban development and joint use potential associated with the light rail system. This analysis suggested where the light rail system might encourage development or redevelopment, including joint development projects where private developers build over and around transit stations. In joint development projects, the developer sometimes contributes financially to the construction and/or operation of the transit system for the privilege of having the transit system integrated into the overall development project.

The Proposed Light Rail System

The proposed light rail line begins near I-270 near Brown Campus, in St. Louis County, and runs generally east along Norfolk & Western right-of-way past Lindbergh Boulevard, McDonnell-Douglas and Lambert International Airport. Where the Norfolk & Western tracks cross Florissant Boulevard, the alignment swings south, passes the University of Missouri--St. Louis (UMSL) campus and the old Wabash Station (Delmar). As it crosses under DeBaliviere, the line turns southeast to cross through the northeast tip of Forest Park. East of the Washington University Medical Complex at Kingshighway Boulevard, the alignment follows

railroad right-of-way east past Union Station to Eighth and Spruce Streets, where it enters the abandoned TRRA railroad tunnel under downtown St. Louis. This abandoned rail tunnel passes under the St. Louis central business district, connecting with the Old Post Office at Locust and Eighth Streets, and terminates at the Eads Bridge west approach. From here the light rail line crosses the lower (rail) deck of the Eads Bridge to East St. Louis, swings south on Southern right-of-way to terminate at 5th and 6th Streets in East St. Louis. In addition, there is a branch line which connects the main line at Ferguson with the Northland Shopping Center.

The alternate alignment leaves N & W right-of-way approximately at Kingshighway Boulevard and continues east in the median of Forest Park Parkway and along Market Street until it rejoins the original alignment at 8th and Market in the downtown tunnel.

Technical Reports

This final report presents the study results, findings, and conclusions. It contains, in summary form, the technical information presented in the various technical reports produced during the study. These technical reports are listed below:

Light Rail Goals & Objectives

Community Interaction Plan

Alignment Studies & Problem Areas

Alternate Light Rail Operating Strategies

Power Distribution System Design

Maintenance & Storage Facility

Location & Design of Stations, Auto Intercept Facilities, & Route Termini

Station Site Screening

Joint Development Analysis along the N & W Railway Right-of-Way

Joint Development Analysis along the Market Street Alignment

Development Potential & Impact

Impact of Light Rail on the Existing Bus System

Overview of the Individual Choice Models for the St. Louis Area

Visual/Environmental Impacts

Projected Travel Demand & Patronage

System Capital Costs

System Operating Costs & Revenues

Financial Plan

Cost/Benefit Assessment

Community Interaction Report

Copies of these technical reports were distributed to each member of the Technical Advisory Committee for review and comment over the course of the study. Copies are also on file with the Bi-State Development Agency.

GOALS & SUBGOALS

The initial step in evaluating the feasibility of a light rail transit system for St. Louis was to establish goals and subgoals.

Methodology

The process used in establishing goals and subgoals can generally be outlined as follows:

*Reviewed goals developed by local/regional agencies

*Using these goals as a starting point, developed a list of preliminary goals and subgoals (objectives)

*Reviewed preliminary goals and subgoals with citizen and technical groups and revised accordingly

*Weighted the goals and subgoals according to citizen and technical groups' priorities

*Subjected goals and subgoals to a final review and weighting by citizen and technical groups

Goals

The following lists the goals adopted for this study:

1. Improve transportation
2. Promote economic development
3. Improve the quality of the environment
4. Conserve energy

Subgoals

Under each major goal, subgoals were developed through the process defined above. Subgoals are specific statements of the more general goals, and could be considered "objectives" as well as "subgoals." The adopted goals and their associated subgoals are presented in Table 1.

Table 1
GOALS & SUBGOALS

Goal A: Improve Transportation

1. Improve access to the St. Louis CBD
2. Improve access to activity centers
3. Reduce vehicular traffic congestion
4. Improve transit efficiency
5. Improve cost-effectiveness of transit
6. Encourage greater use of existing transportation resources
7. Minimize capital costs
8. Improve transit service to elderly/handicapped
9. Improve transit service to transit dependents

Goal B: Promote Economic Development

1. Reinforce downtown St. Louis as the point of regional focus
2. Stimulate and direct new development
3. Complement existing and planned development
4. Promote more efficient and rational use of land

Goal C: Improve the Quality of the Environment

1. Improve air quality
2. Minimize noise impact
3. Minimize impact on historical sites
4. Minimize community (neighborhood) disruption
5. Improve aesthetic quality
6. Minimize construction impact

Goal D: Conserve Energy

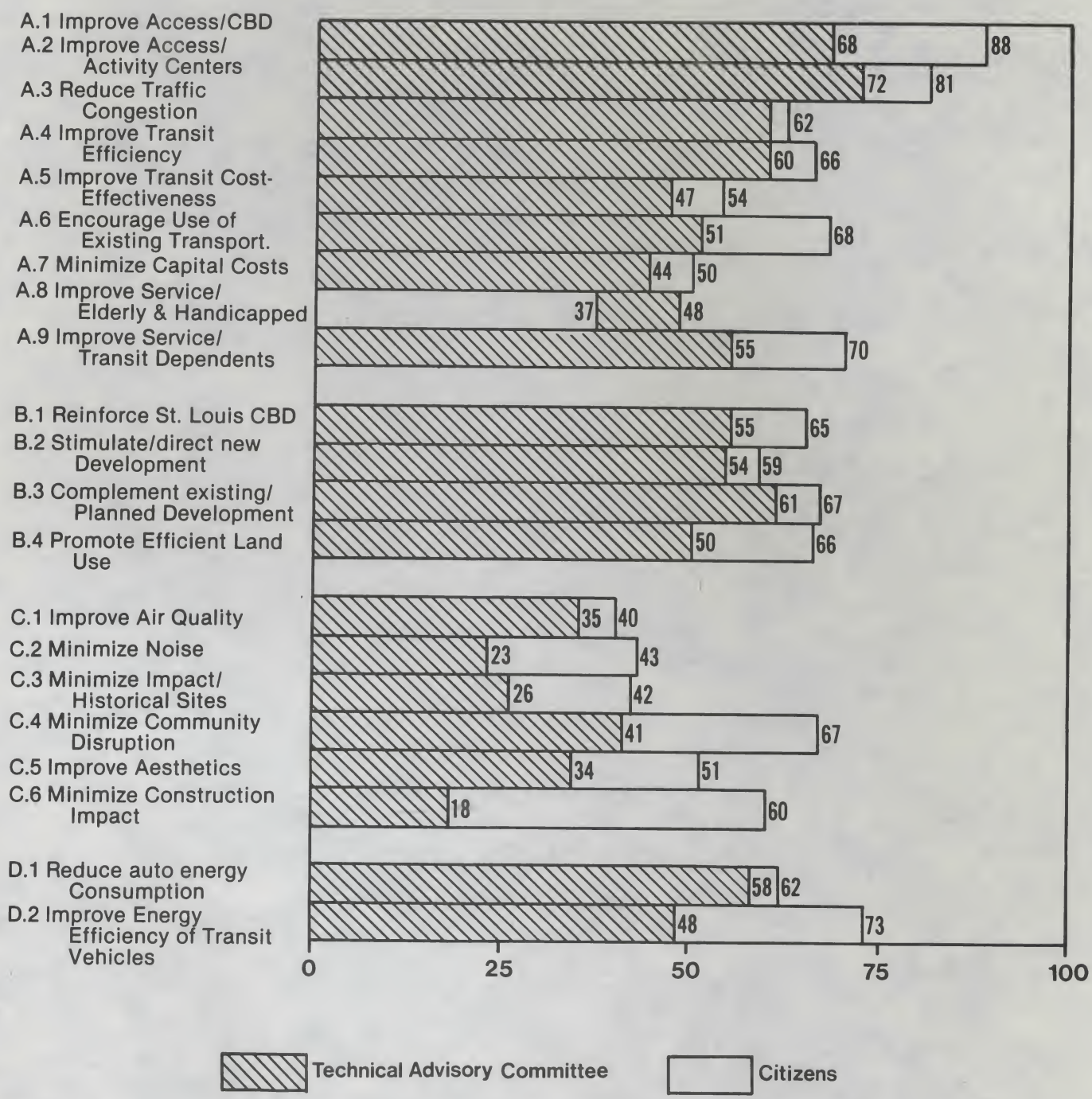
1. Reduce automobile energy consumption
2. Improve energy efficiency of transit vehicles

After deciding on the statement of goals and subgoals, various citizen and technical committees were asked to weight or rank each subgoal in terms of its importance or value. The results of this weighting process are presented in Figure 1 and Table 2.

In general both the citizens and the Technical Advisory Committee ranked the environmental subgoals lower than the other subgoals, with transportation-related subgoals ranked highest. However, the citizens' ratings on all of the subgoals were higher than the Technical Advisory Committee's except subgoal A.8, Improve Service for the Elderly and Handicapped, which was the subgoal ranked lowest by the citizens at 37%, and a mid-ranked subgoal on the Technical Advisory Committee scale at 48%. Both citizens and the Technical Advisory Committee ranked goals A.1 and A.2, Improve Access to the St. Louis CBD and to Activity Centers, the highest, but the Technical Advisory Committee felt that the activity centers were more important while the citizens stressed the CBD. The Advisory Committee placed far more emphasis on subgoals A.3, Reduce Traffic Congestion,and A.4, Improve Transit Efficiency, ranked fourth in importance, than the citizens did, ranking these two subgoals only about midway between the most and least important subgoals. Other large discrepancies fell in the rankings of subgoals D.2, Improve the Energy Efficiency of Transit Vehicles, and C.4, Minimize Community Disruption, which were considered substantially more important by the citizens than by the Technical Advisory Committee. The Technical Advisory Committee, on the other hand, placed greater stress on subgoals B.2, Stimulate/Direct New Development and D.1, Reduce Auto Energy Consumption, than the citizens.

Figure 1

COMPARISON OF CITIZENS AND TECHNICAL ADVISORY COMMITTEE SCORES BY SUB-GOALS



COMPARISON OF SUBGOAL RANKINGS
Citizens/Technical Advisory Committee

Technical Advisory Committee	Citizen Groups
A.2 Improve Access/Activity Centers (72%)	A.1 Improve Access/St. Louis CBD (88%)
A.1 Improve Access/St. Louis CBD (68%)	A.2 Improve Access/Activity Centers (81%)
B.3 Complement Existing/ Planned Development (61%)	D.2 Improve Energy Efficiency of Transit Vehicles (73%)
A.3, A.4 Reduce Traffic Congestion, Improve Transit Efficiency (60%)	A.9 Improve Service/Transit Dependents (70%)
D.1 Reduce Auto Energy Consumption (58%)	A.6 Encourage Use of Existing Transportation Facilities (68%)
B.1, A.9 Reinforce St. Louis CBD, Improve Service/ Transit Dependents (55%)	B.3, C.4 Complement Existing Development, Minimize Community Disruption (67%)
B.2 Stimulate/Direct New Development (54%)	A.4, B.4 Improve Transit Efficiency, Promote Efficient Land Use (66%)
A.6 Encourage Use of Existing Transportation Facilities (51%)	B.1 Reinforce St. Louis CBD (65%)
B.4 Promote Efficient Land Use (50%)	A.3, D.1 Reduce Traffic Congestion, Reduce Auto Energy Consumption (62%)
D.2, A.8 Reduce Auto Energy Consumption, Improve Service/Elderly & Handicapped (48%)	C.6 Minimize Construction Impact (60%)
A.5 Improve Transit Cost-Effectiveness (47%)	B.2 Stimulate/Direct New Development (59%)
A.7 Minimize Capital Costs (44%)	A.5 Improve Transit Cost-Effectiveness (54%)
C.4 Minimize Community Disruption (41%)	C.5 Improve Aesthetics (51%)
C.1 Improve Air Quality (35%)	A.7 Minimize Capital Costs (44%)
C.5 Improve Aesthetics (34%)	C.2 Minimize Noise (43%)
C.3 Minimize Impact/Historical Sites (26%)	C.3 Minimize Impact/Historical Sites (42%)
C.2 Minimize Noise (23%)	C.1 Improve Air Quality (40%)
C.6 Minimize Construction Impact (18%)	A.8 Improve Service/Elderly & Handicapped (37%)

DESCRIPTION OF THE SYSTEM

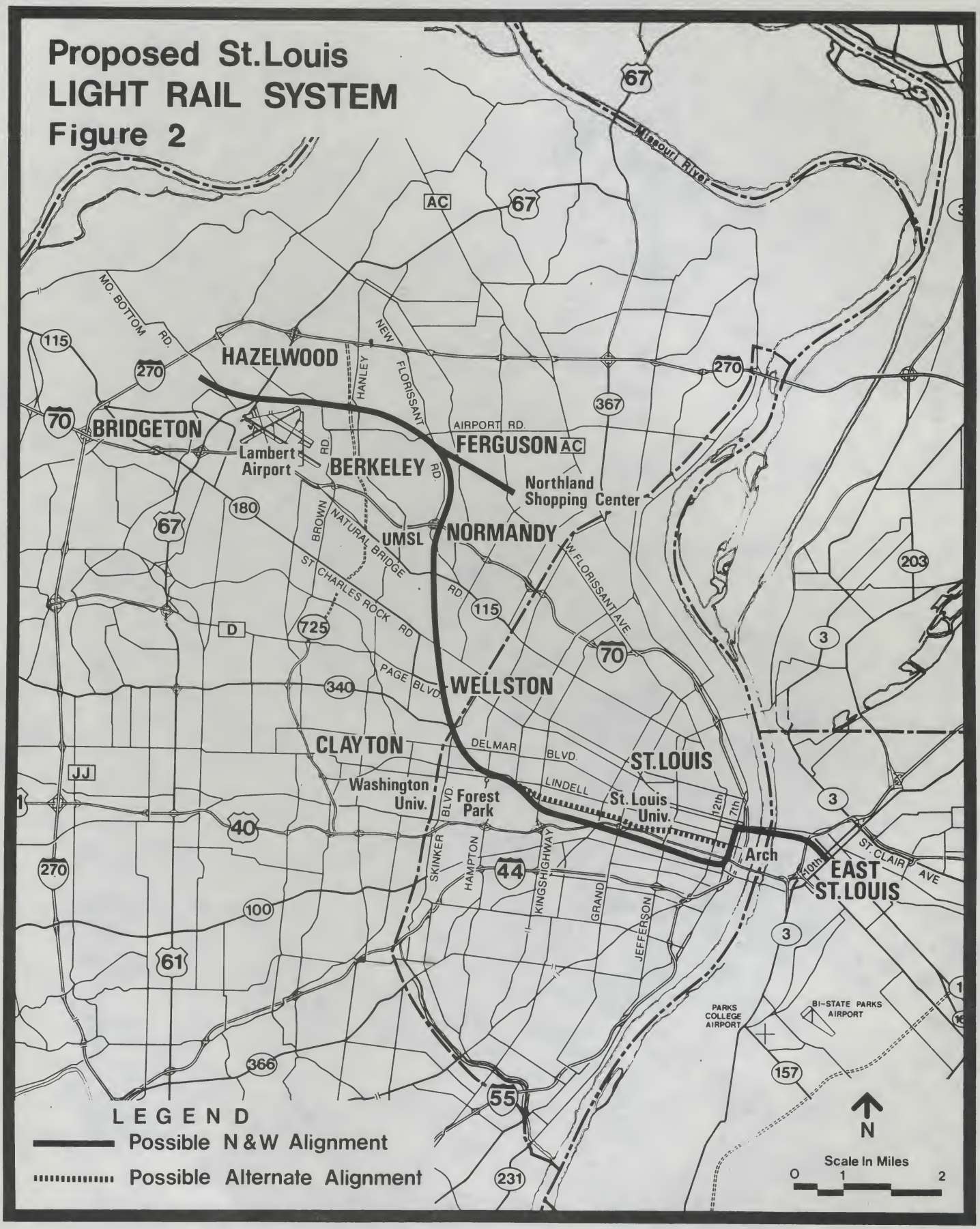
The proposed light rail system evaluated in this study, was initially selected because previous studies have concluded that it lies within a corridor that has the greatest potential for rail transit. In addition to providing service to downtown St. Louis and East St. Louis, the proposed light rail system also serves numerous activity and employment centers. Moreover the proposed alignment makes maximum use of existing transportation resources (railroad rights-of-way), rather than requiring the construction of a new transit corridor through already developed areas.

General Alignment

The proposed 22-mile light rail corridor, generally defined in Figure 2, was conceived of as two new light rail tracks alongside existing railroad tracks, either at-grade, elevated, or subway, depending on available rights-of-way and grades. It was hoped that existing railroad rights-of-way would be adequate and available for both railroad and transit operations.

The alignment, starting at the western end, begins in the vicinity of Interstate 270 and the Norfolk & Western underpass and travels in a southeasterly direction, crossing under Missouri Bottoms Road, and then turns almost due east. It then crosses over Lindbergh Boulevard and follows Banshee Road (actually north of Banshee Road) to the intersection of Brown and Banshee Roads.

From the Brown and Banshee Road intersection, the alignment continues in an easterly direction, crossing Hanley Road, Evergreen Avenue, Airport Road, and Florissant Boulevard in Ferguson.


Proposed St.Louis
LIGHT RAIL SYSTEM
Figure 2
Missouri River
HAZELWOOD
BRIDGETON
Lambert Airport
BERKELEY
FERGUSON
AIRPORT RD.
Northland Shopping Center
NORMANDY
UMSL
W. FLORISSANT AVE
WELLSTON
CLAYTON
Washington Univ.
Forest Park
DELMAR BLVD.
ST.LOUIS
St. Louis Univ.
Arch
EAST ST.LOUIS
ST. CLAIR AVE
PARKS COLLEGE AIRPORT
BI-STATE PARKS AIRPORT
MO. BOTTOM RD.
NEW FLORISSANT RD.
HANLEY RD.
BROWN RD.
NATURAL BRIDGE RD.
ST CHARLES ROCK RD
PAGE BLVD
SKINKER BLVD
HAMPTON
KINGSHIGHWAY
GRAND
JEFFERSON
LINDELL
12th
7th
10th
LEGEND
Possible N&W Alignment
Possible Alternate Alignment
N
Scale In Miles
0 1 2

East of Florissant Boulevard the alignment turns south, past Woodstock Road, I-70, Florissant Boulevard, to Natural Bridge Road. From here the alignment continues in a southerly direction crossing St. Charles Rock Road, Page Boulevard, Etzel Avenue, and enters the City of St. Louis in the vicinity of Skinker Boulevard. From Skinker Boulevard the alignment turns toward the east, crossing Delmar Boulevard, Kingsbury Avenue, Waterman Boulevard, and DeBaliviere Avenue. At DeBaliviere the alignment parallels Forest Park Parkway, passing under Union Boulevard, Lindell Boulevard, and crossing the northeastern corner of Forest Park to Kingshighway.

The alignment at Kingshighway continues almost due east along the Norfolk & Western tracks, crossing Euclid, Newstead, and Boyle Avenues, Sarah Street, Vandeventer Avenue, Spring Avenue, and Grand Boulevard, just south of Highway 40. From Grand Boulevard the alignment continues east, south of Highway 40, past Compton Avenue, Jefferson Avenue, 18th Street, and Tucker (12th Bouelvard) to 8th Street where it enters the abandoned TRRA railroad tunnel which runs under 8th Street and Washington Avenue through downtown St. Louis.

The TRRA tunnel lies under 8th Street, crossing, in a northward direction, Walnut Street, Market Street, Pine Street, Olive Street, and Locust Street to Washington Avenue. At Washington Avenue the tunnel bends to the east again,crossing under Broadway and 4th Street before emerging on the lower deck of the Eads Bridge.

The proposed alignment continues across the Eads Bridge, also owned by TRRA, into Illinois, basically following an alignment south of Broadway under Interstate 55/70 to a point just south of Walnut Avenue (unimproved) at 6th Street. From I-55/70 to 6th Street

the alignment follows the unused Southern Railway right-of-way.

For the purposes of this study, this alignment is normally referred to as the N & W alignment because it parallels the Norfolk & Western Railroad for much of its length.

Alternate Forest Park Alignment

The alternate alignment is identical to the Norfolk & Western alignment as described previously, except for the section between Kingshighway and 8th Street. Here the alternate alignment leaves the Norfolk & Western right-of-way just west of Kingshighway, crosses Kingshighway, then enters the median of Forest Park Boulevard, where it continues east to Market and Compton Streets where it follows Market Street into downtown St. Louis and enters the tunnel at 8th and Market Streets.

Branch to Northland Shopping Center

A proposed branch line would leave the main line just south of Florissant Boulevard and follow the abandoned St. Louis Belt and Terminal Railway right-of-way under Bermuda Avenue and the N & W main line, continuing to Northland Shopping Center parallel to the N & W main line.

Operating Plan

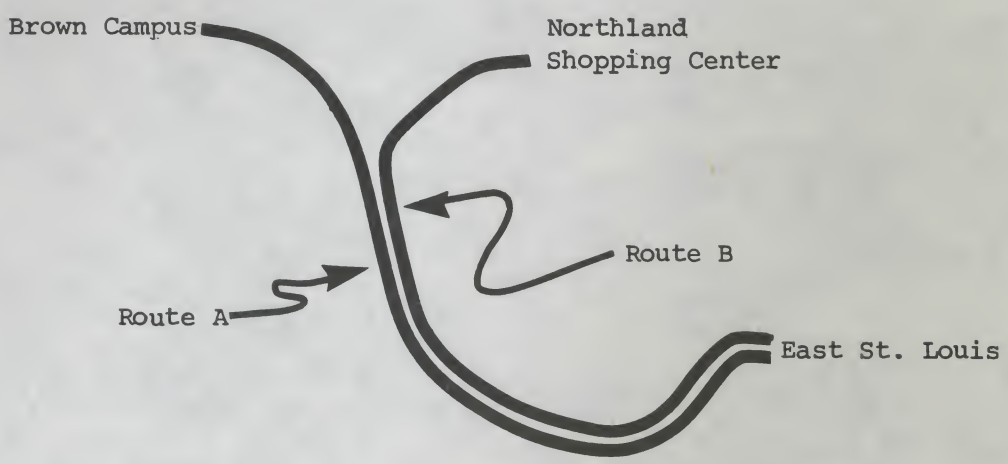
The following defines the light rail transit operating plan developed for this study:

Hours of Service: 6:00 a.m. to 12:00 midnight, daily including weekends and holidays

Average Operating Speed: 32 m.p.h. as allowed by station spacing

Level of Service:	6:00 a.m. to 9:00 a.m. - 10-min. headways 9:00 a.m. to 3:30 p.m. - 20-min. headways 3:30 p.m. to 6:30 p.m. - 10-min. headways 6:30 p.m. to midnight - 30-min. headways Saturdays, Sundays, & holidays - 30-min. headways
Type of Service:	Scheduled service with on-line stations, using two routes as shown in diagram below

DIAGRAM SHOWING 2 LINES
ON PROPOSED LIGHT RAIL SYSTEM



This operating plan was reviewed by the Technical Advisory Committee; the hours and level of service presented are those approved by that committee. The average operating speed of 32 m.p.h. is the average system speed resulting from the preliminary station locations approved by this committee.

A review of system capacity and estimated patronage has shown a need to provide for two-car trains during the peak hours from 6:00 a.m. to 9:00 a.m. and 3:30 p.m. to 6:30 p.m. A higher cost alternative would involve an increase in the frequency of service during peak periods, say, to one train every 5 minutes, rather than

one train every 10 minutes.

Selected Route Termini

The specific terminal points for the light rail system were carefully selected to minimize construction costs, to provide adequate area for station construction, including park-and-ride facilities, and to provide good bus, auto, and walk access. Moreover, the terminal locations were selected to serve, if possible, a major development and to intercept major commuter travel corridors.

I-270 and Brown Campus: The recommended terminus for the western end of the line lies immediately adjacent to the southern boundary of Brown Campus, and east of I-270, on the south side of the Norfolk and Western tracks. The site is presently vacant, but lacks adequate access roads.

Consideration was given to terminating the line at Lindbergh Boulevard, but this solution was rejected due to the following:

*The Brown Campus terminal location provides for much better opportunities to intercept auto traffic, especially from I-270.

*The Brown Campus location has more vacant land suitable for construction of a station and park-and-ride facilities.

*Access to the Brown Campus location would be significantly improved with the planned reconstruction of Missouri Bottoms Road and the construction of an interchange at I-270 and Missouri Bottoms Road.

*The Brown Campus location is a more convenient and direct transfer point for bus lines servicing St. Charles and

northwest St. Louis County if these bus lines were terminated at the light rail station, rather than continuing to downtown St. Louis.

A terminal station west of I-270 was also considered, but was rejected for the following reasons:

*Although land is available, access to a terminal site west of I-270 is not as good as that east of I-270.

*A terminal station west of I-270 would not serve the employment concentrations in Brown Campus.

*Additional construction costs, including modifications to the I-270 overpass, would be required if the line continued west of I-270.

The recommended terminal location is shown in Figure 3, which also illustrates a suggested raodway access system connecting Campus Parkway at Missouri Bottoms Road with Fee Fee Road. The future interchange at I-270 and Missouri Bottoms Road and the widening/reconstruction of Missouri Bottoms Road are important elements of any access system at this terminal station.

East St. Louis: There are several possible terminal locations in East St. Louis. The recommended location lies south of Broadway between Fifth and Sixth Streets on the abandoned Southern Railway right-of-way. This site is adjacent to the new community college, which is under construction, and lies within walking distance of the new City Hall and federal courts building. The site has excellent access, being approximately one block south of Broadway and having direct access to I-55/70. (Figure 4.)

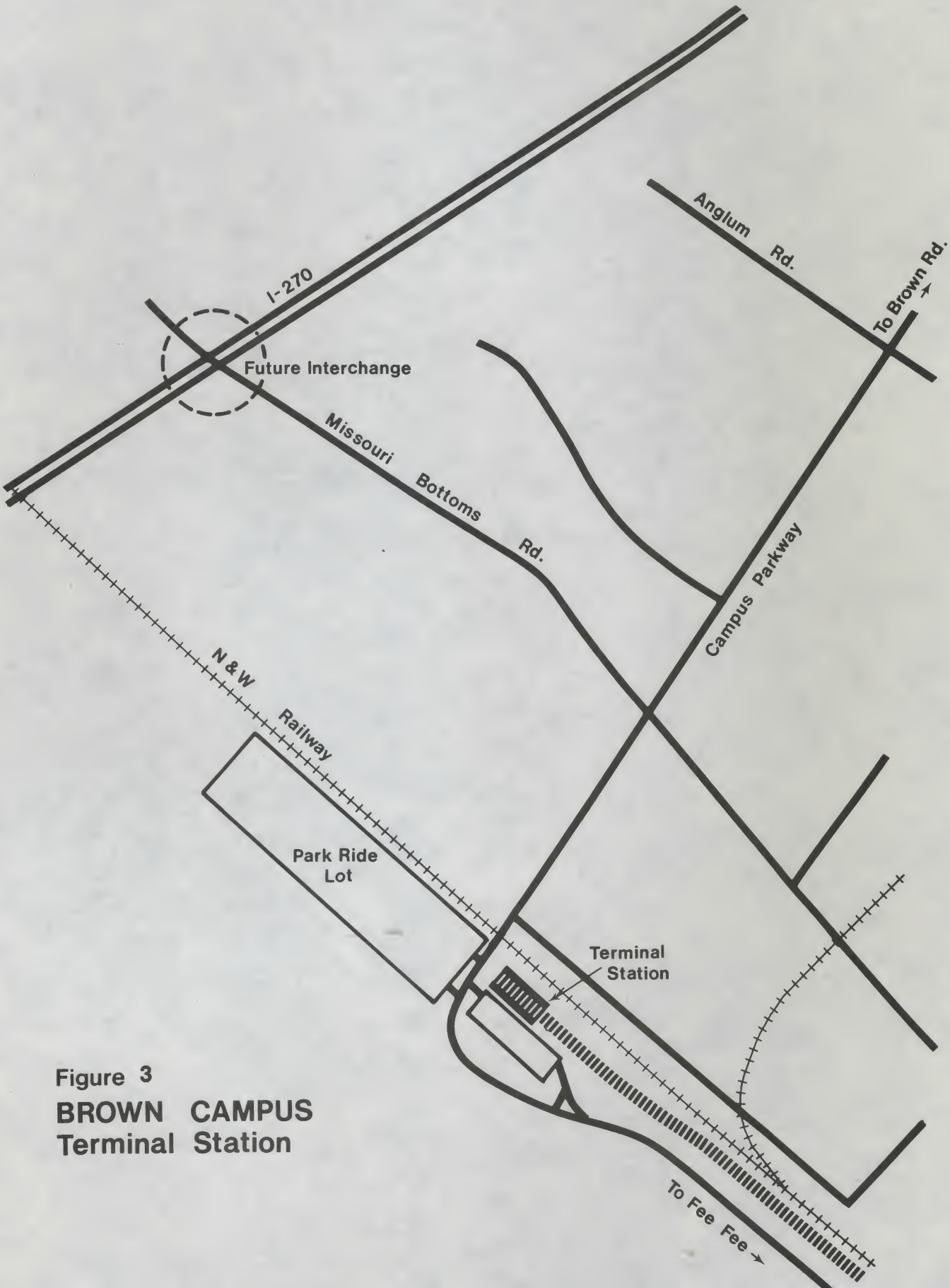


Figure 3
BROWN CAMPUS
Terminal Station

EAST ST. LOUIS DEVELOPMENT

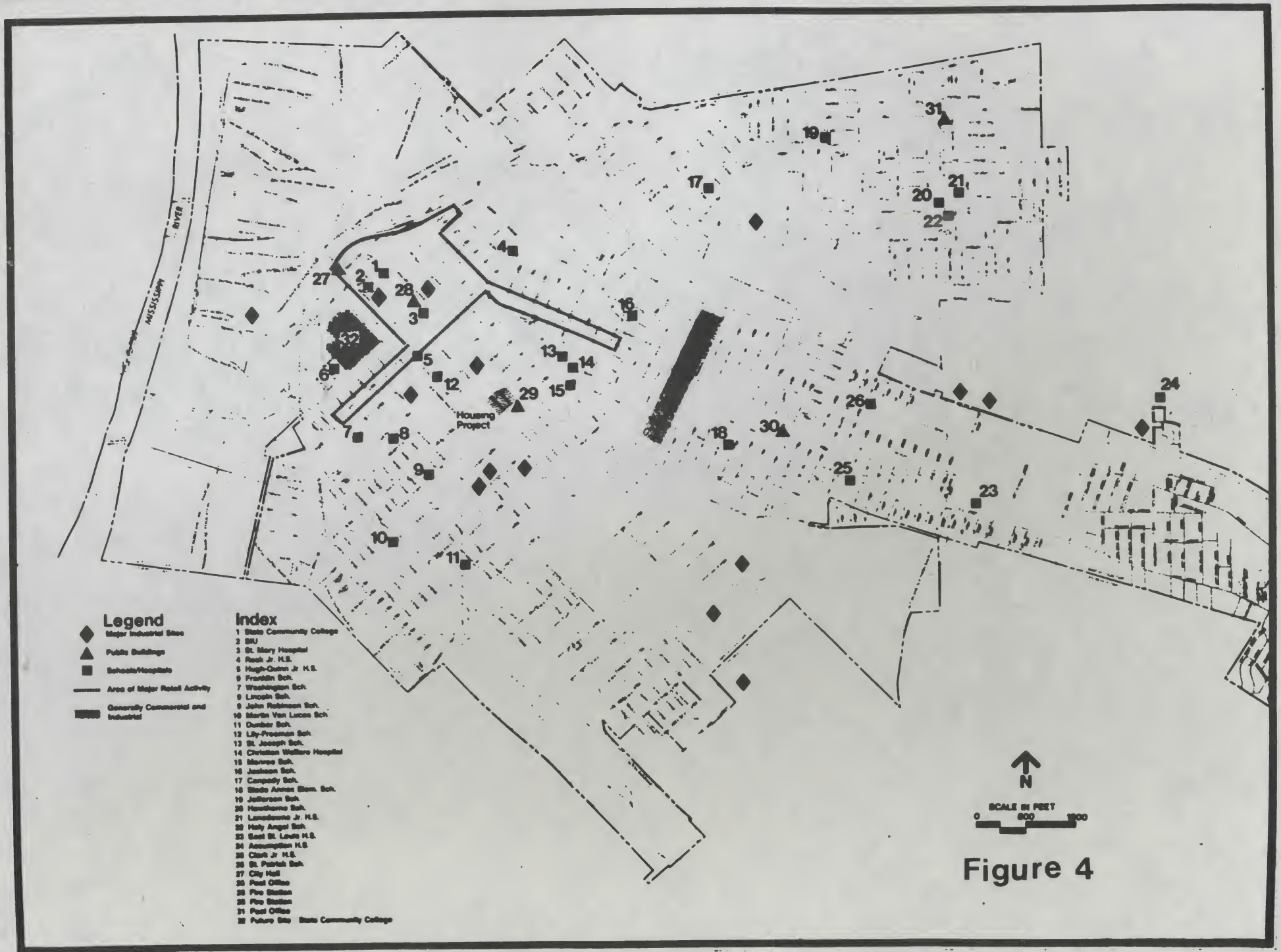


Figure 4

Alternate terminal locations were considered, as discussed below:

*Immediately west of I-55/70 and south of Broadway. This location was rejected because it did not serve downtown East St. Louis well. (It is farther away than the location selected.) It does have the advantage of being a better auto intercept point for westbound I-70 traffic going to St. Louis. Although the site was rejected as a terminal location, it could still be developed as an additional station or stop in the future, either to serve riverfront development or as an auto intercept point.

*A northern CBD location in the vicinity of the I-55/70 and I-64 interchange near Collinsville Avenue. This location was also rejected primarily because it would not serve downtown East St. Louis and would require more costly construction.

Another primary consideration in selecting a terminal location in East St. Louis was the potential for future system expansion. All of the three alternate locations described above allow for ultimate extension of the light rail system eastward, perhaps to Belleville. From the recommended location at Fifth/Sixth Streets, the light rail system can be extended eastward along the Southern Railway either continuing on to Belleville or swinging north to tie into the Louisville and Nashville Railroad via Southern or Alton and Southern Railroad rights-of-way.

Figure 5 illustrates the recommended location and access plan for the East St. Louis terminal station. It provides for

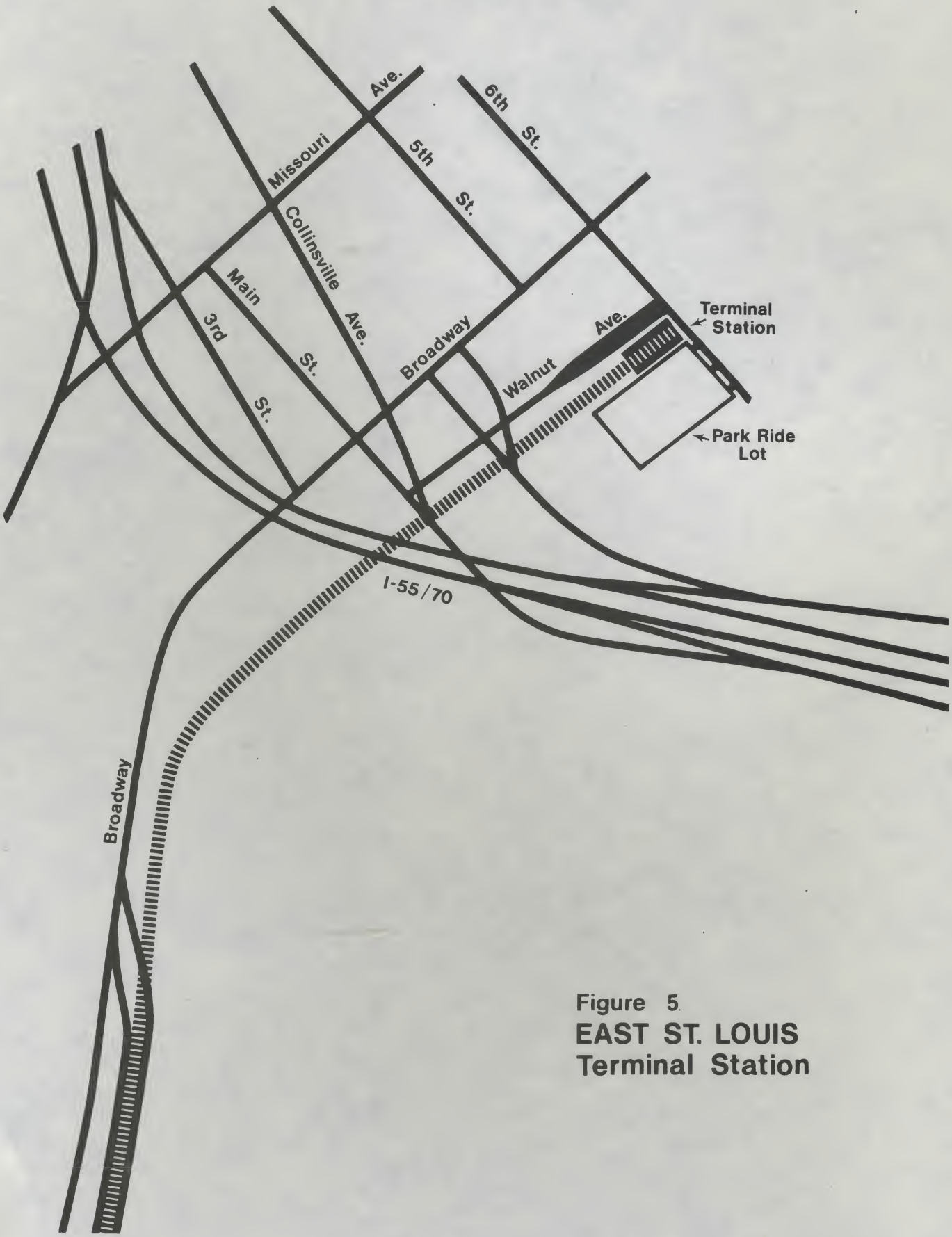


Figure 5
EAST ST. LOUIS
Terminal Station

improvement and extension of Walnut Avenue as the main access link to the station and the construction of a park-and-ride lot adjacent.to Sixth Street.

Northland Shopping Center: The recommended terminal for the light rail line to Northland Shopping Center is immediately west of Lucas and Hunt Road, just south of the existing N & W tracks in the northeast corner of the shopping center. Discussions with officials of the May Company, owners of the Northland Shopping Center led to the selection of this location. The primary reason for selecting this location was land availability; this corner of the shopping center is less active than other areas, and could more easily be developed as a terminal station. In fact the May Company expressed interest in a joint development project which would include a multi-level parking structure to serve both the shopping center and light rail patrons.

An alternate location was also considered that would have terminated the light rail line immediately west of West Florissant Avenue. It was rejected because it did not provide direct access to the shopping cetner, and vacant land was not available for the construction of a station and park-and-ride facilities. This alternate location does have the advantages of being less costly and closer to Emerson Electric Company. Access to the alternate location would be primarily from West Florissant Avenue.

The recommended location does not have particularly good auto access at present. It is expected that an improved roadway would be necessary along the north side of the shopping center from West Florissant Avenue to Lucas and Hunt Road. This roadway would

help ensure that commuter traffic to and from the light rail station does not disrupt internal shopping center traffic circulation and would provide a direct link to both West Florissant Avenue and Lucas & Hunt from the terminal station. Figure 6 illustrates the recommended terminal station location and the proposed access improvements.

Selected Station Locations

Methodology: To begin the station location evaluation process, all the possible station sites along the alignments were identified (theoretically every point where a street crosses the alignments). This resulted in about sixty possibilities.

Socioeconomic and traffic projections for the target year, 1995, along with current data on access roads, transit service, and major trip attractors were complied for the areas along the alignment (up to one mile on either side). Since the zones vary substantially in size, socioeconomic data were converted to densities, i.e. people per acre, employees per acre, etc., to give a comparable unit for each zone. The majority of this data was abstracted from East-West Gateway publications and supplemented with information provided by the City of St. Louis Community Development Agency and the St. Louis County Department of Planning.

This data was mapped to see where concentrations coincided (or failed to coincide) with prospective station locations. The possible sites were then evaluated for accessibility, via both automobile and existing transit routes, and joint development potential. The joint development analysis was provided by Robert Harmon Associates.

Figure 6
NORTHLAND SHOPPING CENTER Terminal Station

Field Reconnaissance: The consultant visited each of the sites under consideration to supplement and verify the accuracy of aerial photographs and mapping. Representatives of Robert Harmon Associates also toured the neighborhoods surrounding each prospective station to evaluate development potential and real estate values.

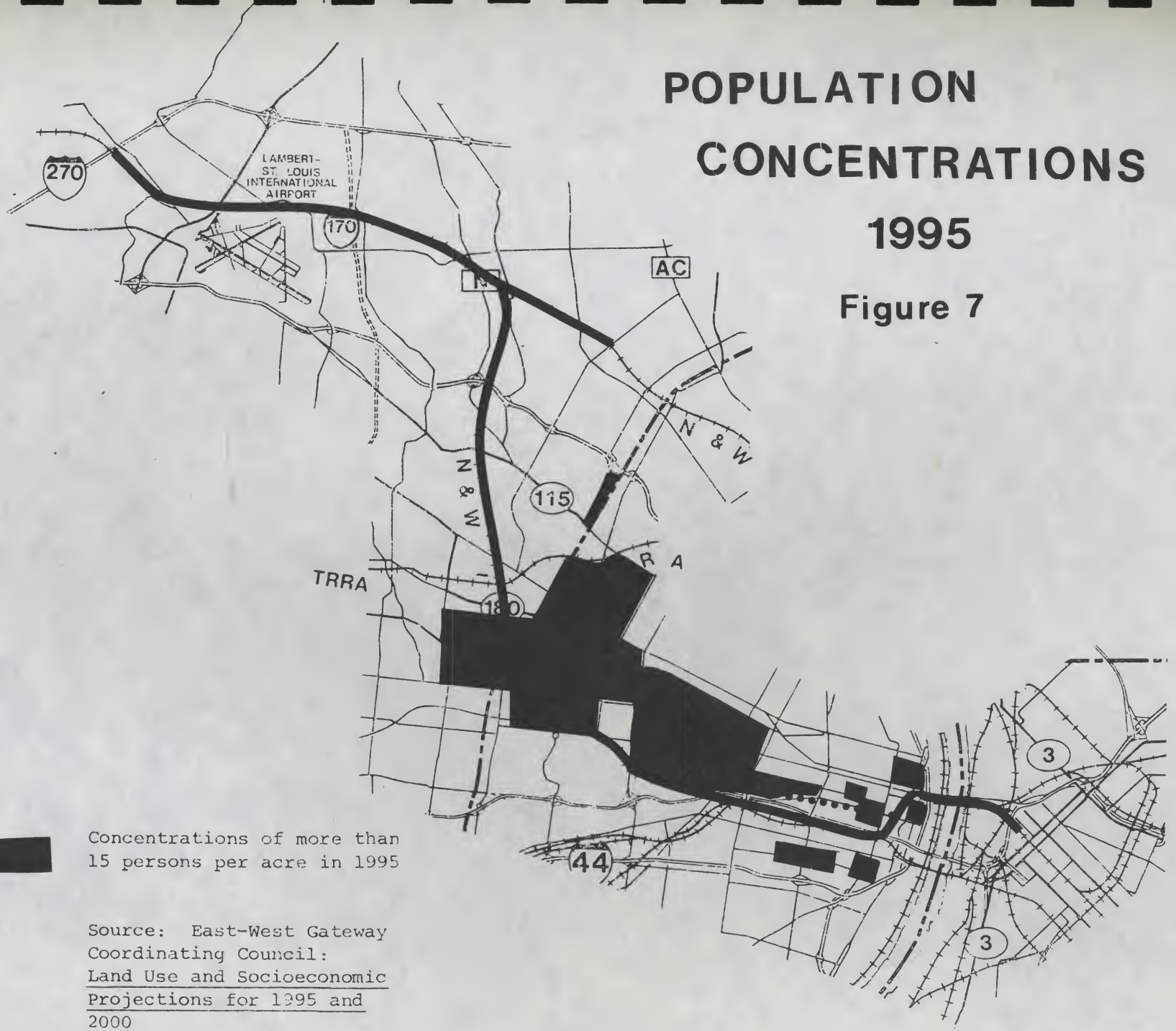
Population Concentrations: The areas adjacent to the alignment that are expected to house 15 or more persons per acre by 1995 are shown in Figure 7. They lie principally within St. Louis City limits, north of the alignments,between Jefferson Avenue and the City line to the west. Two zones lying in St. Louis County but bordering the City line on the east are also expected to show high population concentrations by 1995, one between Delmar and Page and the other between St. Charles Rock Road and I-70. There are also scattered dense patches throughout the downtown area.

Employment Concentrations: Areas along the alignments expected to support 50 or more jobs per acre by 1995 are even more concentrated, lying almost exclusively in downtown St. Louis (Figure 8). The one exception is the zone just north of the airport that contains McDonnell-Douglas. There are several other industrial areas in St. Louis County that support large numbers of employees--Lambert International Airport and Brown Campus for example, that are not shown on the map because these facilities occupy such large tracts of land that despite large numbers of employees, they do not have large concentrations of employees per acre.

Trip End Concentrations: Another measure of potential ridership

POPULATION CONCENTRATIONS 1995

Figure 7

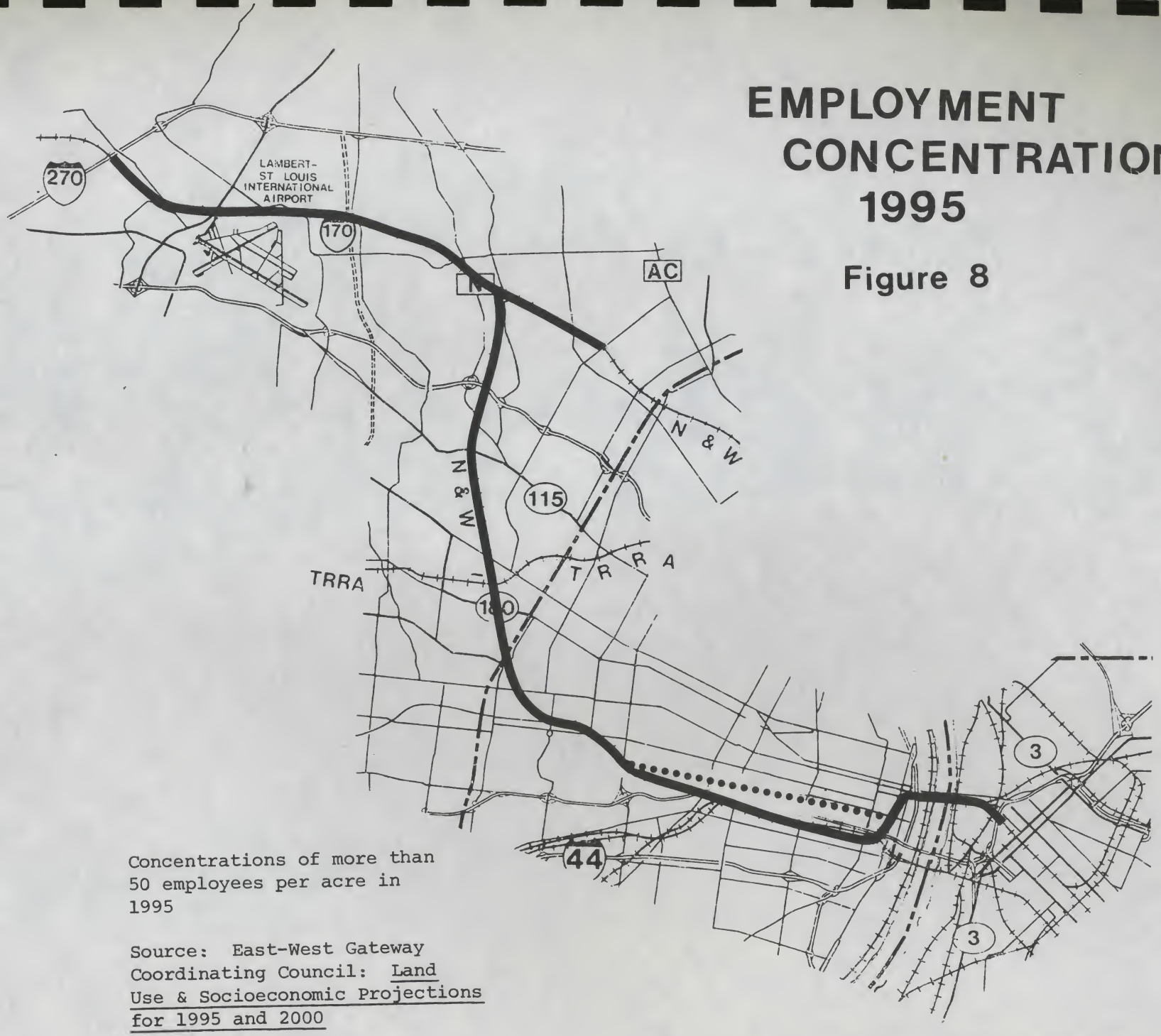


Concentrations of more than 15 persons per acre in 1995

Source: East-West Gateway Coordinating Council: Land Use and Socioeconomic Projections for 1995 and 2000

EMPLOYMENT CONCENTRATIONS 1995

Figure 8



Concentrations of more than 50 employees per acre in 1995

Source: East-West Gateway Coordinating Council: Land Use & Socioeconomic Projections for 1995 and 2000

is travel demand, trips beginning or ending in a certain area. Areas such as the few blocks containing Northland Shopping Center, Emerson Electric, and the residential neighborhoods surrounding them may not be ranked particularly high on either population or employment, but collectively the two functions may generate a great many trips. Figure 9 shows areas that are expected to generate 100 or more trip ends per acre by 1995.

Downtown St. Louis is, of course, an area which both draws and emits large numbers of travelers. Other such areas are the Washington University Medical Complex, Lambert International Airport and its support facilities, St. Louis University, a small area around Skinker and Olive, and Northland Shopping Center, along with the small area just east of it.

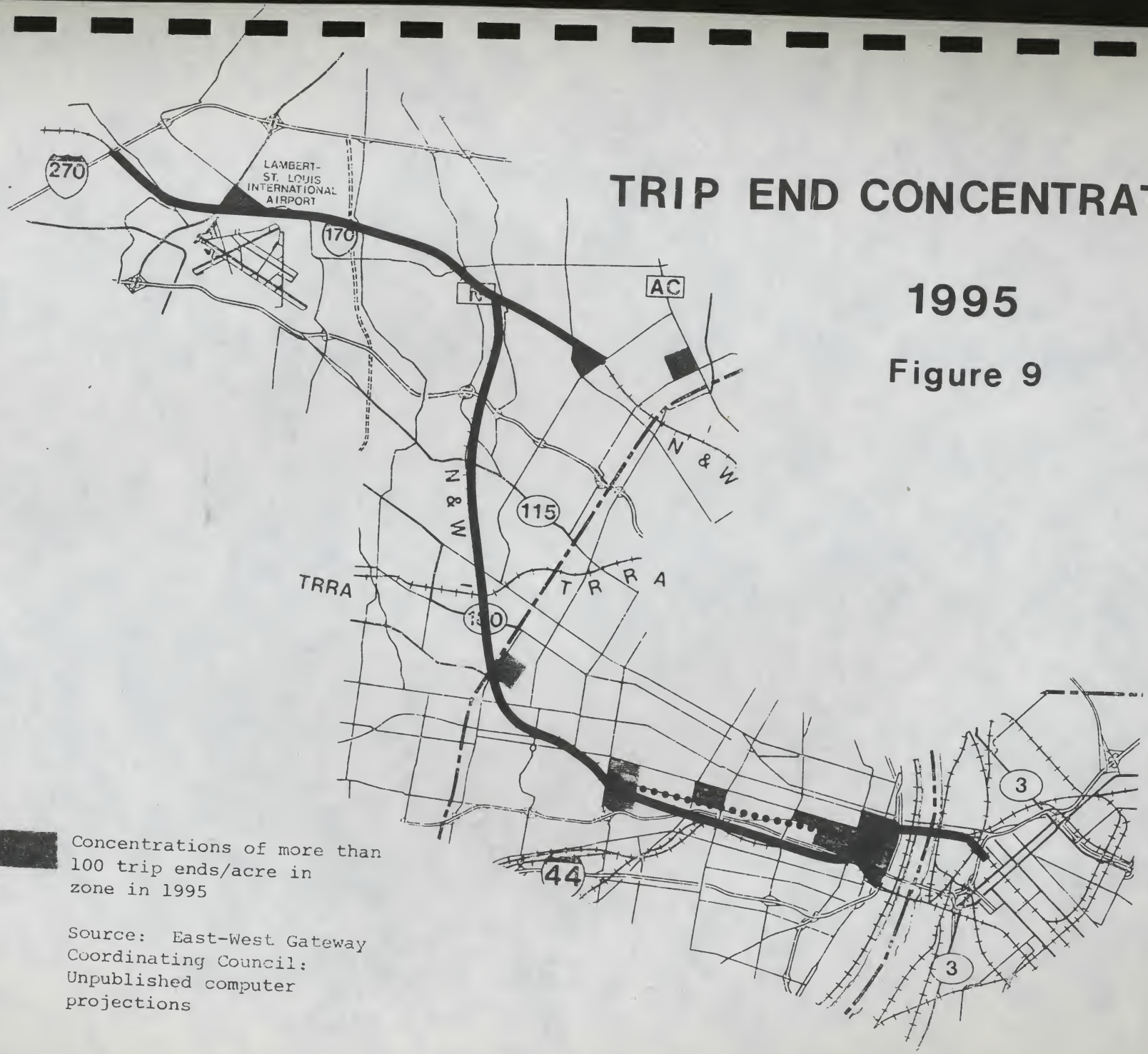
Major Travel Generators: Although the "bread and butter" of any transit system is people travelling to and from work, many people use transit for other types of trips as well. Figure 10 shows the 1995 employment concentrations, along with other people-attractors such as shopping centers, hospitals, Lambert International Airport (drawing travellers as well as employees), colleges and universities, apartment complexes, and business and industrial parks (drawing visitors, salespeople, customers, as well as employees).

There are a number of major generators just north of the alignments betweeen downtown St. Louis and the medical complex at Kingshighway Boulevard. A cluster of hospitals, a large apartment complex, and the University of Missouri at St. Louis combine to make the area between I-70 and Page a prime stretch for one or more stations. The shopping center at Northland and a number of

TRIP END CONCENTRATION

1995

Figure 9

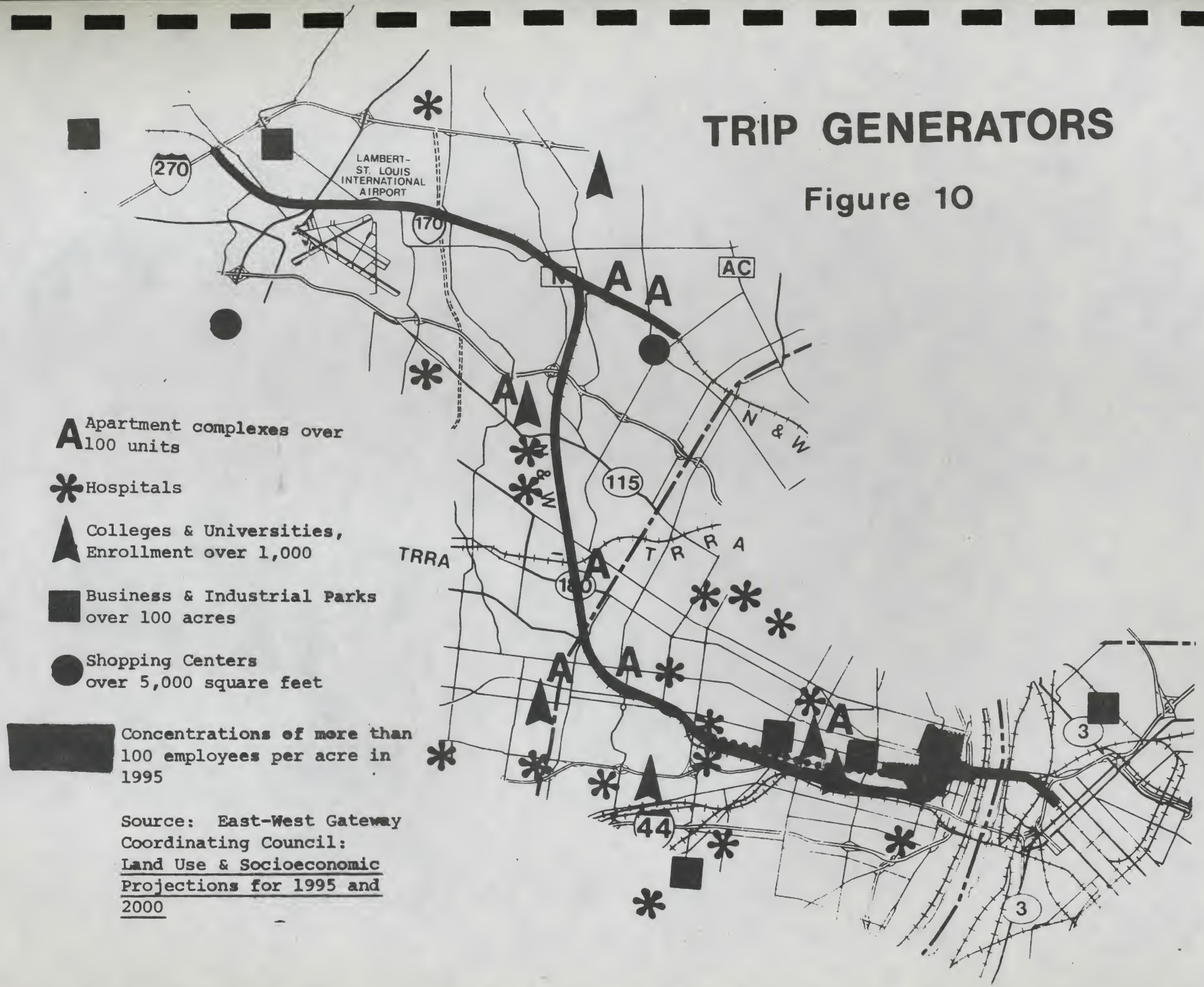


Concentrations of more than 100 trip ends/acre in zone in 1995

Source: East-West Gateway Coordinating Council: Unpublished computer projections

TRIP GENERATORS

Figure 10



A Apartment complexes over 100 units

Hospitals

Colleges & Universities, Enrollment over 1,000

Business & Industrial Parks over 100 acres

Shopping Centers over 5,000 square feet

Concentrations of more than 100 employees per acre in 1995

Source: East-West Gateway Coordinating Council: Land Use & Socioeconomic Projections for 1995 and 2000

surrounding apartment complexes suggest that this also might be an area that could support a transit station.

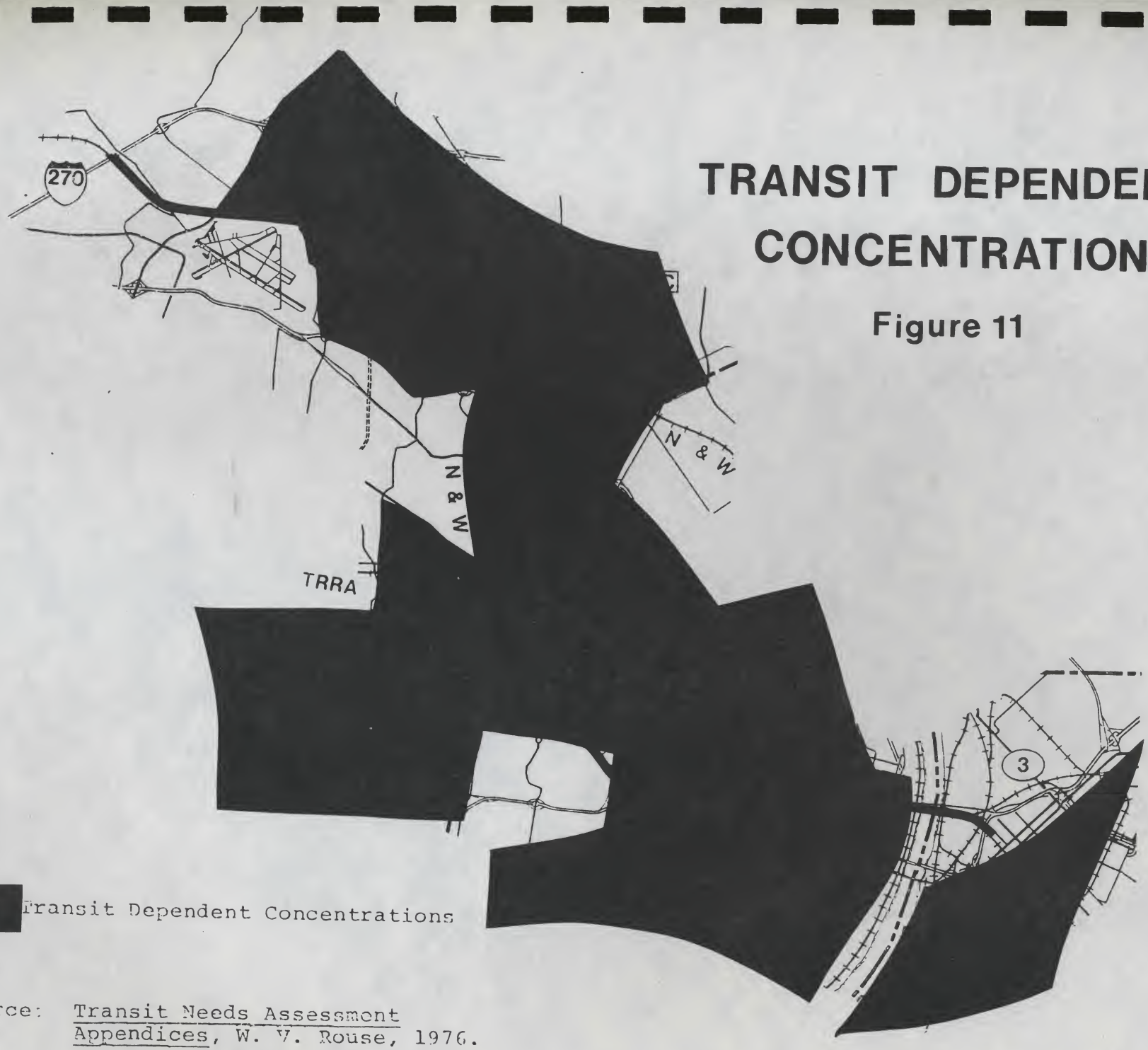
Transit Dependent Concentrations: One goal of any transit system is to provide transportation for the transit dependent person, one who has no access to an automobile. Such people are typically the elderly, the young, the economically disadvantaged, the handicapped, and members of one-car families when the one car is otherwise spoken for. Due to the broad range of people involved, the areas with large concentrations are quite widespread, see Figure 11. Virtually all of the possible station locations would serve large numbers of transit dependent people.

Approved Redevelopment Areas: Another goal of transit service, particularly capital-intensive, fixed route service, is to support economic development. Therefore, one criterion for selecting station sites is whether a site would serve a redevelopment area. The redevelopment areas in the City of St. Louis, approved under Chapters 353, 100, and 99 are shown in Figure 12. Practically any cross street from downtown St. Louis as far west as the City limits would serve one or more of these areas.

Current Transit Service: To fully utilize all transit investment, a light rail system should be linked to, and its stations accessible by, existing or projected bus service. Nearly all of the station sites on major roads mesh with existing bus lines, and several, I-70, Florissant, Page, St. Charles Rock Road, Delmar, Kingshighway, and Vandeventer at U.S. 40, for example, meet major trunks crossing a variety of routes serving areawide destinations.

TRANSIT DEPENDENT CONCENTRATIONS

Figure 11

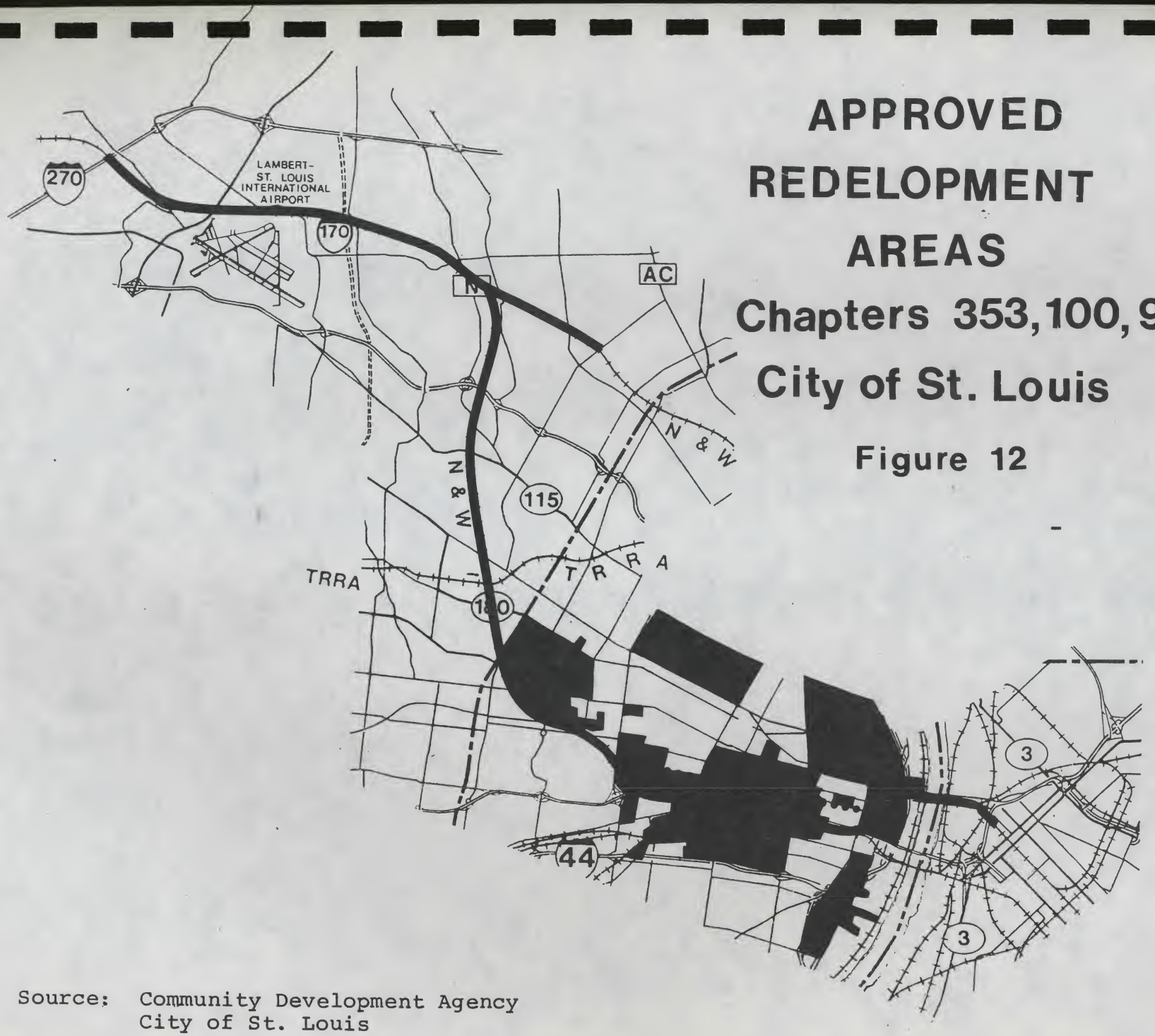


Transit Dependent Concentrations

Source: Transit Needs Assessment Appendices, W. V. Rouse, 1976.

APPROVED REDELOPMENT AREAS
Chapters 353,100,99
City of St. Louis

Figure 12



Source: Community Development Agency
City of St. Louis

Auto Access: On the premise that potential passengers will not take the time to use transit if the station is not readily accessible, the station locations were evaluated on the basis of approach road capacity. Roads with at least four lanes (two in each direction) were preferred because normally these provide adequate capacity for both normal traffic and traffic to and from transit stations. Again, stations on major streets ranked high on this criterion, and those served by small, winding, residential streets did not.

Joint Development Potential: Robert Harmon Associates selected the station locations which offered the greatest potential for joint development. To assist in this analysis, they divided the alignments into several sectors, each of which is discussed below.

RHA felt that East St. Louis had a fair amount of development potential due to such factors as land availability, multi-line rail service, and the city's proximity to the regional core. However, the difficulties involved in realizing this potential are so great, they felt, that a light rail line and station by themselves would not provide sufficient impetus to spur measurable development. The system would serve a useful role as part of a "package deal" if investment (public and private) could be attracted concurrently with light rail construction. Until such investment is available, however, they rated East St. Louis sites as having "low priority" for joint development.

Due to the recently completed, current, and committed construction within the St. Louis CBD, along with the City's statutory redevelopment tools, RHA felt that downtown St. Louis showed strong potential for

joint development, and, therefore, termed a number of sites in the CBD "high priority." These include Eads Bridge (near Laclede's Landing), 6th and Washington (near the proposed May Mall and the Cervantes Convention Center), 8th and Locust (the old post office), and the intersections of 8th Street and Walnut, Market, Chestnut, Pine, and Olive.

RHA found moderate development potential along the corridor west of the St. Louis CBD to the City line, due in part fo the stabilizing influence of the medical complex around Kingshighway. The significant barrier to development supporting a light rail system on the original alignment is Highway 40, which separates potential patrons in the residential areas to the north from the light rail alignment, which lies to the south. The alternate alignment solves this problem, lying north of Highway 40 near the residential areas. One way or the other RHA felt that a station should be located somewhere in this stretch to serve hospital patrons and employees at the Kingshighway/Euclid complex, and rated both the Euclid and Taylor sites "medium priority."

As the alignments enter St. Louis County, RHA found a number of sites with joint development potential, as nearly all of the County sites are surrounded by at least some land parcels suitable for development, and the alignments serve a number of generators (McDonnell-Douglas, Lambert International Airport, the commercial strips in Ferguson, the University of Missouri at St. Louis) on which to anchor future development. The intersection of the alignments and Missouri Bottoms Road was rated "high priority," and several other locations in St. Louis County--Florissant Road,

Airport Road, and Lindbergh Boulevard, and Northland Shopping Center were rated "medium priority." Finally, several additional locations showed some joint development potential, including Natural Bridge, I-70, Hanley, the Innerbelt, and Brown Road.

Review with Technical Advisory Committee: This information was presented to the Technical Advisory Committee members, who supplemented it with personal experience to arrive at the following recommendations.

I-270/Missouri Bottoms Road: The site has adequate available land to build a park-and-ride lot, and provides convenient access (via shuttle bus) to the rapidly expanding Brown Campus to the east. The only drawback to the site, one which should be reasonably easy to resolve, is the lack of direct access from I-270.

Lindbergh/Missouri Bottoms Road: This site was located to serve McDonnell-Douglas and airport traffic and can intercept the numerous bus routes travelling Lindbergh Boulevard.

Brown and Hanley Roads: Brown Road serves surrounding residential areas better than Hanley, while Hanley is better positioned to intercept bus routes. The Committee decided to place stations at both sites to provide the system with both sets of advantages.

Florissant Road: A station on this site would serve the surrounding residential and commercial districts, and has the added advantage of there already being an unused station at the intersection.

I-70: The Committee proposed this site to intercept motorists on I-70 and because of the availability of vacant land for park-and-ride facilities. There is also a large residential area north of

I-70 from which to draw patrons.

Natural Bridge Road: A station at this site would serve a number of generators, including the University of Missouri at St. Louis, the Marillac School, St. Vincent's Hospital, and Glen Echo Country Club. The surrounding area is primarily residential, a good source of patrons.

St. Charles Rock Road: The Committee was not enthusiastic about this location, due to its lack of joint development potential; however, a final decision was left until after the patronage figures were run.

Etzel: The Committee selected this site over Page Boulevard in order to better serve the surrounding residential area. In addition there is a vacant piece of property large enough to construct a transit station and access facilities.

Delmar Station: The Committee selected Delmar Station over Skinker/Olive, which basically serves the same residential areas, in order to utilize and rehabilitate the historic structure. It was noted that rehabilitating the Delmar Station would cost rather more than building a new station, as Delmar Station is more elaborate than is necessary, and various committee members felt that funding sources could be found apart from the transit system, due to the building's historic character.

DeBaliviere: A station at this site would support redevelopment already taking place in the area, and, perhaps encourage new investment. In addition, DeBalivière provides direct connections to the residential area to the north, Forest Park to the south, and a number of bus routes utilizing the street.

Kingshighway/Euclid: The Committee agreed that a site would have to be chosen to serve the medical complex along Kingshighway and the Central West End area, but did not indicate a preference for either Kingshighway or Euclid. Kingshighway offers unequalled opportunities for intercepting bus routes, but due to the tunnel under the medical complex it might be simpler to build at Euclid. Medical complex officials will be asked for an opinion.

Boyle Street: Boyle Street is approximately half way between Kingshighway and Grand Avenue, easing the walk for departing passengers wishing a destination between these two streets. It could serve the Blue Cross/Blue Shield complex, and the City plans to improve the street, easing automobile access.

Grand Avenue: The Committee supported this location, as buses using the street have extremely high ridership, indicating that it is a good area for transit, and the street serves a number of generators, particularly St. Louis University.

Jefferson Avenue: The Committee was not enthusiastic about this location, fearing that it would be so close as to drain off patronage from Union Station (18th Street), if that area is developed. If redevelopment plans for Union Station do not proceed, however, Jefferson Avenue has the advantage of intercepting a major bus line.

Eighteenth Street: The Committee supported this location, principally because of the connection with Union Station. In addition the site serves the Union Electric Company office building and, less conveniently, the post office.

Twelfth Street: The Committee agreed to use this location

due to its connections with transit lines on Twelfth Street, and the number of office buildings along the street, including City Hall.

Eighth and Walnut: The Committee selected the intersection of Eighth and Walnut, rather than Eighth and Market to serve the Stadium and also due to the City's concern for the development potential around the proposed station. On the alternate alignment, Eighth and Market will be used, as this alignment does not pass through Eighth and Walnut.

Locust Street: There is considerable interest in redeveloping the old post office at Eighth and Locust, and it already has access to the tunnel. Current building restoration plans call for maintaining the opening for access to the tunnel from the basement of the old post office building.

Washington/Sixth: The Committee supported this location as a good way to serve both the proposed May Mall and the Convention Center.

Laclede's Landing: The Committee approved of this location, as it will serve new development in Laclede's Landing, as well as tourist trade from the Gateway Arch.

East St. Louis (5th & 6th): This site was selected by East St. Louis officials, in consultation with MARGE, to accommodate expected development in East St. Louis and the rail relocation. The proposed station location is adjacent to the site of the new community college currently under construction south of Broadway.

Northland Shopping Center: The Committee supported this site due to its location with respect to patrons from the residential

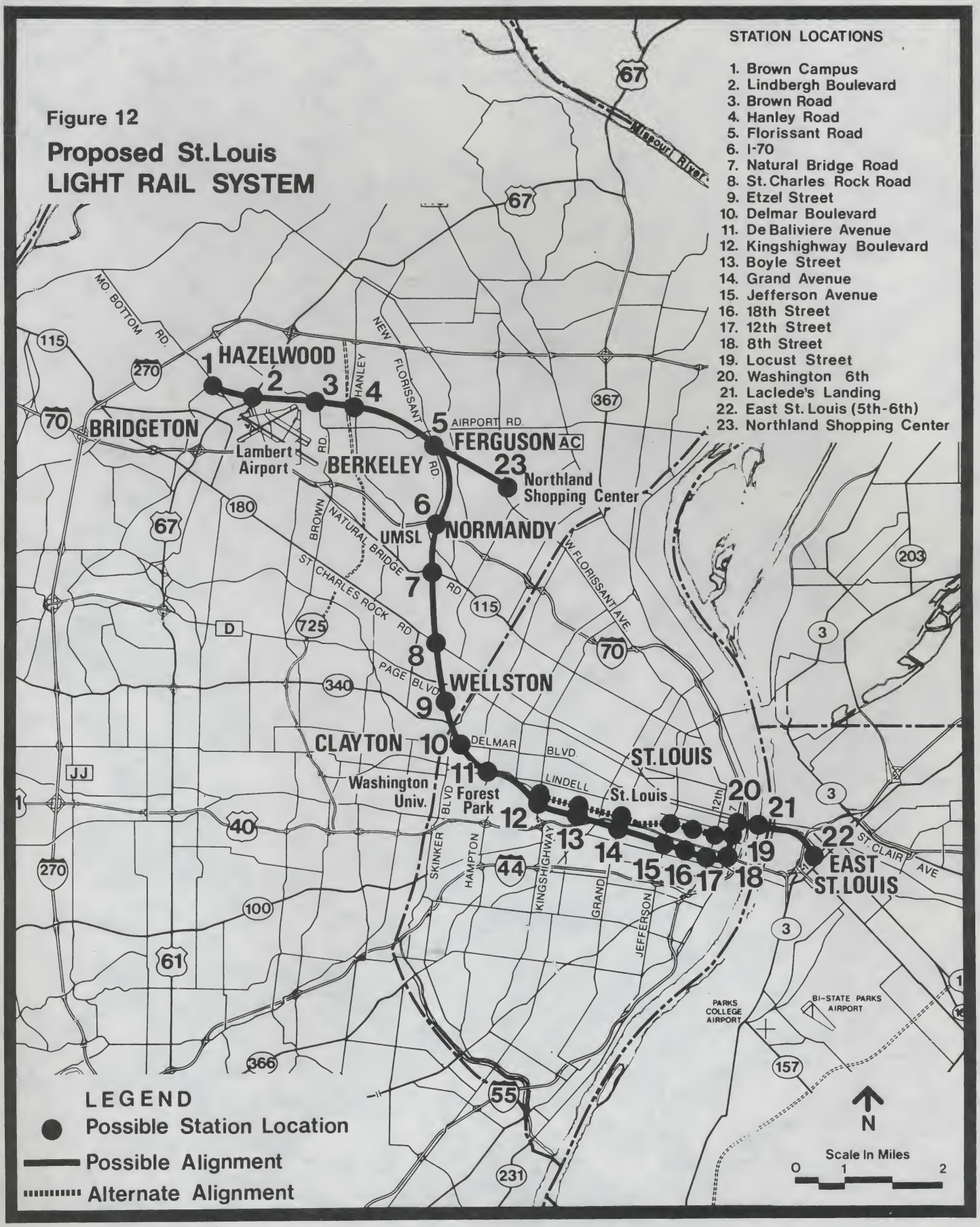
areas surrounding the shopping center, park-and-ride patrons driving in from North County, shoppers going to Northland, and employees going to Emerson Electric, Northland, and the commercial strip immediately north. In addition it intercepts several bus routes travelling both West Florissant and Lucas & Hunt.

Selected Station Locations: Based on the preceding analysis, a review with the Technical Advisory Committee, and a field reconnaissance of each location, the following station locations were selected. See Figure 12.

1. Brown Campus
2. Lindbergh Boulevard
3. Brown Road
4. Hanley Road
5. Florissant Boulevard (Ferguson)
6. I-70
7. Natural Bridge Road
8. St. Charles Rock Road
9. Etzel Street
10. Delmar Boulevard
11. DeBaliviere Avenue
12. Kingshighway/Euclid
13. Boyle Avenue
14. Grand Boulevard
15. Jefferson Avenue
16. 18th Street
17. 12th Street
18. 8th Street
19. Locust Street

Figure 12

Proposed St.Louis LIGHT RAIL SYSTEM



20. Washington Avenue (6th/7th)
21. Laclede's Landing
22. Fifth/Sixth Streets - East St. Louis
23. Northland Shopping Center

Analysis of Potential Auto-Intercept Locations

Each of the selected stations was analyzed to determine its potential as a transfer or auto intercept station. The following criteria were used in this analysis:

*Adjacent to major, heavily travelled freeway, highway, or interchange

*Located prior to major congestion points on freeway or major highways

*Preferably located over 10 miles from CBD, with residential development concentrations within four to six miles beyond the station location

*Clearly visible from major approach roads, with safe and convenient access

*Compatible with adjoining land uses

*Available, preferably vacant

*Preferably located outside suburban activity centers or suburban town centers

Figure 13 shows several stations with unusually good potential for successful auto-intercept facilities, based on the analysis summarized in Table 3.

Functional Description of Outlying Stops/Stations

Outlying station stops can be classified into two functional classes:

1. Station Shelter and Platform Only: Includes a standard

Table 3

ANALYSIS OF AUTO INTERCEPT OR TRANSFER STATIONS

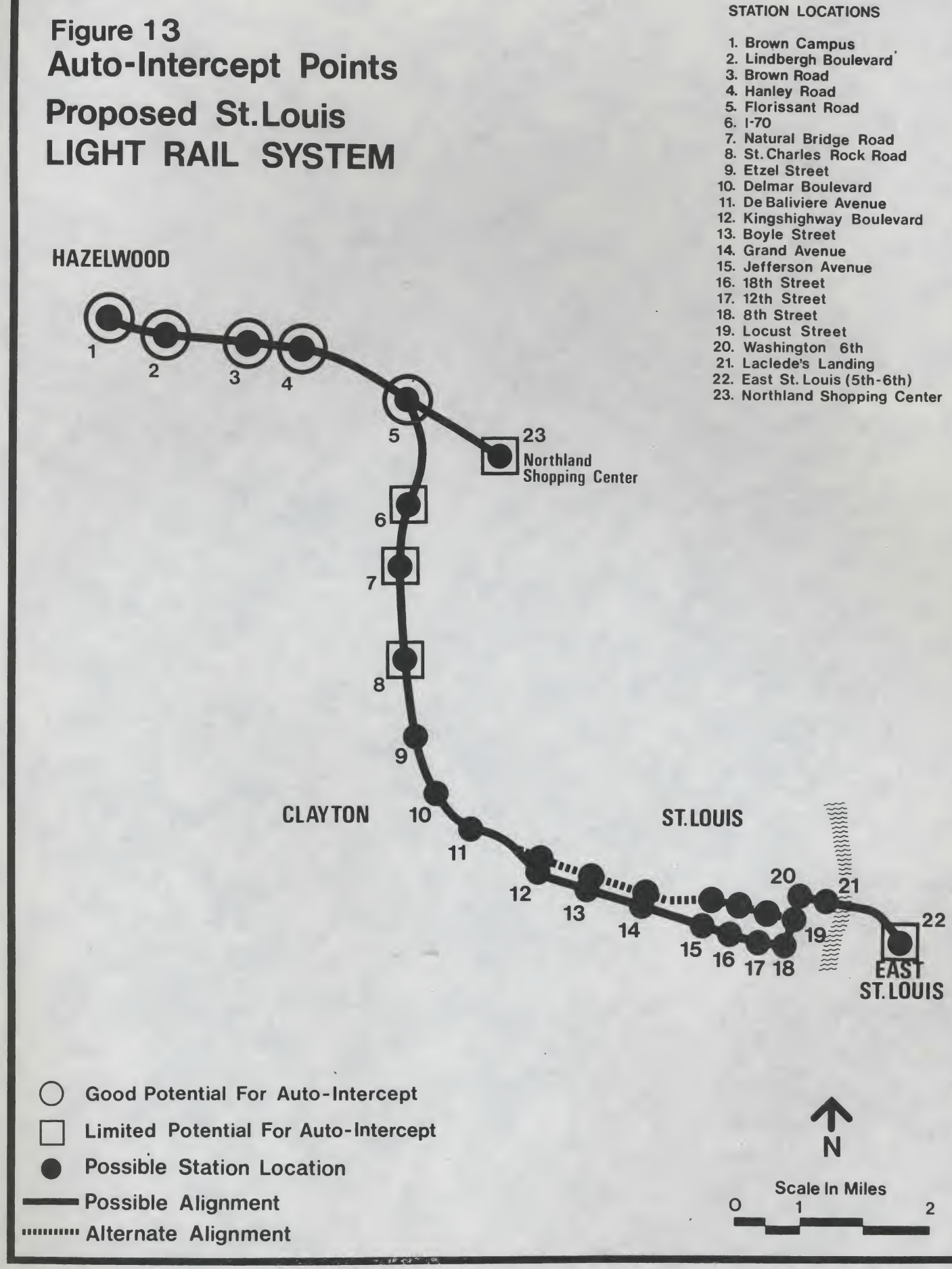
Station	Adjacent to Highway, Freeway or Interchange	Located Prior to Congestion	10 Miles from CBD & near Residential Development	Clearly Visible Site	Compatible w./ Land Use	Available or Vacant Land	Outside Activity or Suburban Center
Brown Campus	Yes, I-270 and Missouri Bottoms Road	Yes, for north County trips	Yes, residential development west & north of I-270	No, unless moved closer to I-270	Yes, industrial	Yes	Yes
Lindbergh Blvd.	Yes, Lindbergh	Somewhat, although Lindbergh is congested in peak periods	Yes, residential development north in Hazelwood & Florissant	Yes, with proper design	Yes, industrial & commercial	Yes, airport clear zone	Yes
Brown Road	Yes, but Brown not as heavily travelled as Lindbergh	Somewhat, but similar to Lindbergh	Yes, but immediate surroundings are industrial	Yes, with proper design	Yes, industrial	Limited	Yes
Hanley Road	Yes, Hanley Rd. rather heavily travelled	Yes, Hanley not badly congested	Yes, but immediate surroundings are industrial	Yes, with proper design	Yes, mostly industrial	Limited	Yes
Florissant Blvd.	Yes, Florissant	Somewhat, although Florissant congested to a limited degree north of the site	Yes, residential development in Ferguson	Somewhat blocked by railroad	Yes, mostly commercial	No	No
I-70	Yes, but access difficult	Somewhat, I-70 congested east of site during peak	No, but surrounded by residential	No, hidden from I-70, Florissant, & Bermuda	No, mostly residential	Yes	Yes
Natural Bridge	Yes, Natural Bridge	Somewhat	No, but surrounded by residential	Yes, with proper design	Yes, mostly institutional	Limited	Yes
St. Charles Rock Road	Yes, St. Charles Rock Road	Somewhat	No, but surrounded by residential	Yes, with proper design	Yes, mostly industrial & commercial	Yes	Yes
Etzel Road	No	No, little congestion to CBD	No	No	Yes, mostly industrial	Very limited	Yes
Delmar Blvd.	No	No, little congestion to CBD	No	Yes, from Delmar	Yes, mostly commercial & industrial	Very limited	Yes
DeBaliviere	Yes, Forest Park Expressway	No, little congestion to CBD	No	Somewhat hidden	Mixture of commercial & residential	Very limited	Yes

Table 3 (cont.)

ANALYSIS OF AUTO INTERCEPT OR TRANSFER STATIONS (cont.)

Station	Adjacent to Highway, Freeway or Interchange	Located Prior To Congestion	10 Miles from CBD & near Residential Development	Clearly Visible Site	Compatible w./ Land Use	Available or Vacant Land	Outside Activity or Suburban Center
Kingshighway	Yes, Kingshighway	No, little congestion to CBD	No	No, probably completely hidden from Kingshighway	Yes, mostly institutional and commercial	Very limited	Yes
Boyle	No	No, little congestion to CBD	No	Not visable except from Boyle	Yes, mostly industrial	Limited	Yes
Grand	Yes, Highway 40	No	No	Probably hidden	Yes, mostly industrial	Yes	Yes
Jefferson	Yes, Highway 40	No	No	Probably hidden	Yes, mostly industrial	Limited	Yes
18th Street	Yes, Highway 40	No	No	Hidden below Highway 40	Yes, industrial	Yes	Yes
12th Street	Yes, Highway 40	No	No	Hidden below Highway 40	Yes, industrial & commercial	Yes	Yes
8th Street	No	No	No	No	No, CBD	No	No
Locust Street	No	No	No	No	No, CBD	No	No
Washington 6th/7th	No	No	No	No	No, CBD	No	No
Laclede's Ldg.	No	No	No	No	No, CBD	No	No
Fifth/Sixth	Yes, I/55-70	Yes	No	Somewhat hidden, elevated freeway	Somewhat, CBD but some industrial	Yes	No
Northland Shopping Ctr.	Yes	Yes	Yes	Yes, from Lucas & Hunt	Yes, commercial	Limited	No

Figure 13
Auto-Intercept Points
Proposed St. Louis LIGHT RAIL SYSTEM



platform layout and shelter, "kiss-and-ride" facilities, feeder bus transfer facilities, bicycle access and storage, and elderly/handicapped access facilities. No provision would be made to accommodate parked vehicles on-site.

2. Station Shelter and Platform with Parking: This class of facility would include all of the provisions discussed above, plus an off-street parking facility to accommodate those wishing to "park-and-ride."

Subway stations and stations designed around existing facilities such as the Delmar Station are not covered in this section. These stations must be designed to fit into surrounding development and to maximize development potential.

Station Design Features: Each of the outlying station facilities will be of a standard design, presenting a uniform image and permitting cost savings. The platform and shelter details are outlined below.

Platform Layout: The standard platform layout will be designed to accommodate a train length of up to three light rail vehicles. Key design criteria are:

Platform height: flush with floor of LRV

Platform length: 220 feet

Minimum platform width: 12 feet measured 7.5 feet from track centerline

Located along the edge of the platform will be a high contrast, 6-inch wide, tactile warning strip indicating train clearance requirements.

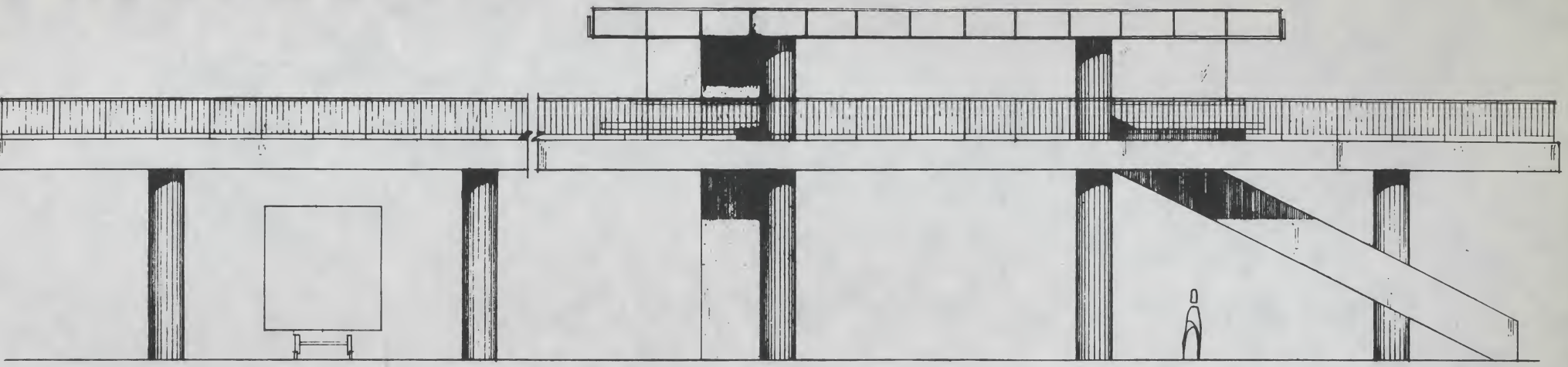
Shelter Features: The shelter is to be a standard design for unmanned station operation. It will be designed to provide protection for the transit patrons from inclement weather and to minimize maintenance expense. The design will conform to the following features:

Architectural Style:	reminescent of earlier train stops in overall roof shape and signage, but painted graphic information and seating design will reflect contemporary atmosphere
Heating, ventilation, & air conditioning:	none
Lighting:	1. platform & shelter lighting 2. high pressure sodium area lights with the placement conforming to individual parking lot geometrics; light standards will be located primarily along the periphery of each parking lot
Telephone system:	Telephone company to provide public pay telephones
Miscellaneous:	Clock, schedule information

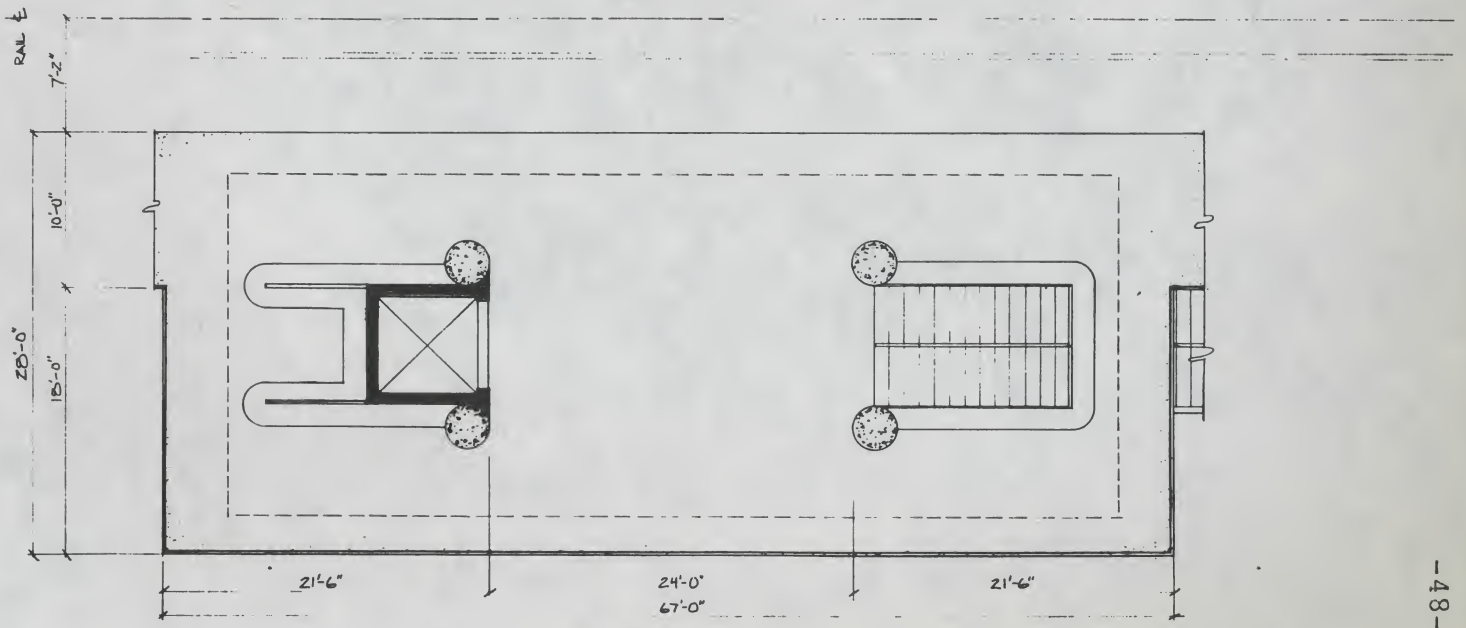
The conceptual design of a prototype station platform and shelter is illustrated in Figures 14 and 15.

Access and Parking Criteria: Specific access and parking lot design will be influenced by the individual needs and geometry of each station site. To minimize potential adverse impact on traffic on the street system around the stations, and to insure that optimum access is provided to LRT stations, certain traffic engineering design criteria should be established. These criteria govern access by all modes as well as accommodation of vehicles at the station site.

Figure 14
Elevated Station

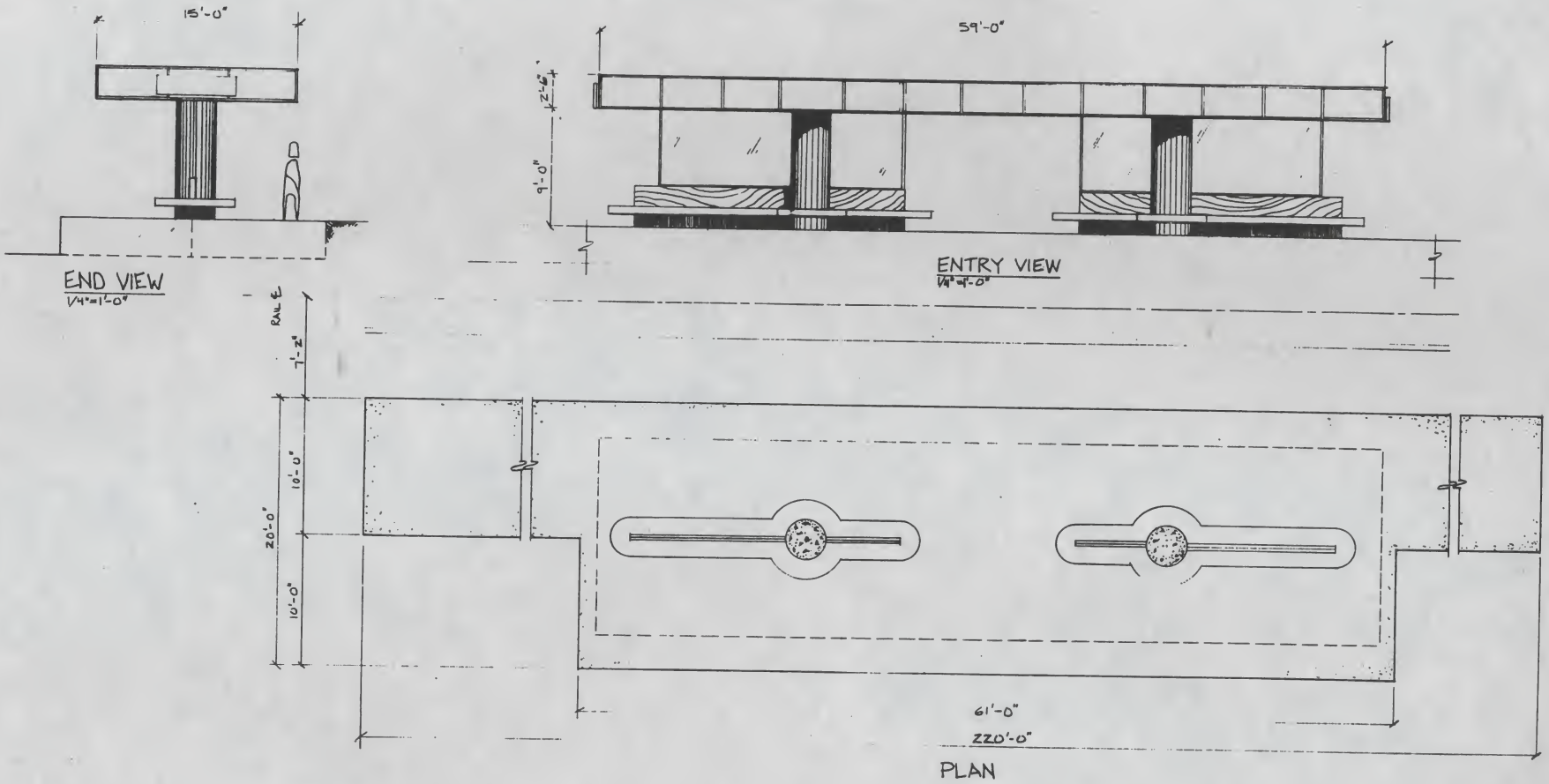


SIDE VIEW
1/4"=1'-0"



PLAN
1/4"=1'-0"

Figure 15
At Grade Station



Access: All stations will be designed to encourage non-auto access, namely bicycles, bus passengers, and walk-ins. Where park-and-ride facilities are planned, auto access will be designed to provide safe and efficient transfer between the adjacent public streets and the station parking lot. Design criteria include:

Directional signing, on- and off-site	(a)	Off-site signs will be strategically located to direct motorists, bicyclists, and pedestrians to stations.
	(b)	On-site signs will be placed to control and manage auto circulation and separate long-term parkers from "kiss-and-ride" motorists.
Bus access	(a)	Placement of bus stops should minimize pedestrian/vehicle conflicts.
	(b)	Bus stops should be located and designed to minimize interference with street traffic and to minimize delay to route schedule adherence.
	(c)	Where on-site bus stops are required, design should encourage priority treatment for buses.
	(d)	Bus stops should be positioned to allow for safe and expeditious transfers between buses and light rail vehicles.
Bicycle access	(a)	Wherever possible, bicycle access provisions should be designed to tie into the area's bicycle route network.
	(b)	Bicycle storage facilities should be accommodated at each station.
Auto access (park-and-ride station sites)	(a)	Separate left turn lanes should be provided for traffic entering the site wherever street width permits.

Auto access (park-and-ride station sites) (cont.)	(b) Driveways should be safely spaced relative to adjacent intersections.
	(c) Streets should be widened, where appropriate, in advance of driveways, to efficiently accommodate vehicles turning right.
	(d) Traffic signals should be provided at driveway locations where state or local traffic engineering warrants are met.

Parking Lot Design: Parking lot requirements should be based on consideration of patronage estimates and land availability. The basis for preliminary determination of the required space for parking facilities at light rail park-and-ride stations is 400 square feet per space required. These figures include space for circulation and for special structures such as light standards, retaining walls, and drainage. Specific layout will be based on obtaining the most use from the space available at each particular station.

The system of traffic circulation produced by the arrangement of parking aisles and stalls will be designed to minimize vehicular travel distances, conflicting movements, and number of turns. Vehicular movements within the parking area shall be dispersed by strategic location of entrances, exits, and aisles, Signing will be designed to efficiently separate long term parkers from those motorists dropping off/picking up passengers.

Aisles shall preferably be aligned to facilitate convenient pedestrian movement toward the station. Stall and aisle dimensions for all-day and for time-limited parking such as for kiss-and-ride use, will generally conform to national parking standards, taking

into account the trend toward smaller cars. The small car stalls will be clearly delineated, so as to be readily apparent to motorists.

Time-limited parking facilities (kiss-and-ride) should be located as near the station platform entrance as practicable, and shall be physically separated so as not to appear to be an integral part of long term parking areas within the lot.

Approximately 2% of the total number of parking spaces will be allocated to the handicapped. Designated handicapped parking stalls shall be nearest to the station platform entrance, with wheelchair access ramps to the platform. Bicycle storage facilities will also be provided at all outlying passenger stops.

The parking facility itself should be designed so that drainage will be directed away from the areas where pedestrians walk. The slope of the pavement will be not less than 1% and not greater than 10%.

Landscaping Features: Landscaped areas will be provided, generally along the perimeter of the parking lots to serve as a buffer from adjacent properties, and also to enhance traffic channelization.

ENGINEERING ASSESSMENT

The following describes the engineering assessment of the proposed light rail alignment. This assessment was based on the following assumptions:

1. Existing, unused railroad rights-of-way will be used wherever possible.
2. There will be no degradation in railroad service because of light rail operations.
3. Existing railroad tracks and sidings will remain in service, but with the possibility of some minor shifting to allow for light rail construction.

The proposed light rail alignment and engineering solutions have been reviewed with railroad officials, who are in general agreement with the proposed alignment. However, formal approval must follow final engineering and design work.

I-270 (Brown Campus) to Brown Road

Starting at the proposed terminus just east of I-270 at Campus Parkway, the light rail alignment runs at grade along the south side of the N & W tracks. The proposed alignment then enters a deep cut under the Missouri Bottoms Road structure. This structure must be rebuilt, since it can only accommodate the one existing N & W track. East of Missouri Bottoms Road the alignment is elevated to cross over to the north side of the railroad tracks and continues on elevated structure over Lindbergh Boulevard and some side tracks before it returns to grade. The reconstruction and relocation of Lindbergh Boulevard tends to create problems which can be solved

during the design phase. After a few hundred feet at grade, the proposed light rail alignment is again elevated to cross over an access road and Cold Water Creek, before returning to grade and continuing there to an at-grade station proposed just west of Brown Road and north of the N & W tracks.

Significant engineering problems include:

1. Reconstruction of Missouri Bottoms Road bridge
2. Access and design constraints at new Lindbergh Boulevard crossing
3. Physical constraints, vertical and horizontal, at McDonnell-Douglas

In general, the N & W right-of-way varies between 150 and 300 feet in width along this section. This is adequate for both the N & W and light rail tracks.

Brown Road to Florissant Road

At Brown Road the proposed alignment enters a new tunnel, which crosses under the N & W tracks and Brown Road and emerges south of the railroad tracks about 1,500 feet east of Brown Road. The tunnel section was necessary to avoid crossing this heavily travelled roadway at grade. An elevated section was impossible due to lack of vertical clearance at the end of runway 24-9. After leaving the tunnel, the alignment remains at grade to Florissant Road south of the existing N & W tracks, although the structure at Dade Avenue will have to be modified to provide room for the light rail tracks. The at-grade street crossing at Evergreen Avenue would remain.

Significant engineering problems include:

1. Physical constraints, particularly vertical, at Brown Road

2. The grade crossing at Evergreen Avenue
3. Modification of the Dade Avenue structure
4. Relocation of team track west of Florissant Road

Florissant Road to Natural Bridge Road

From Florissant Road the alignment continues east then south toward Natural Bridge Road. Throughout this section the light rail alignment lies along the west side of the existing N & W tracks. South of Florissant Road the alignment goes through some rough terrain and encounters one rather severe right-of-way constraint. Between Adams and Short Streets in Ferguson, the alignment follows along Redmond Street. The right-of-way between Redmond Street and the N & W tracks is extremely limited; in fact, existing mapping shows Redmond Street partially constructed on N & W right-of-way, leaving no space at all for the light rail tracks. The most probable solution would be to construct light rail tracks along Redmond Avenue, which would greatly affect the houses facing this section of Redmond Avenue.

Continuing on south, the alignment enters a high fill section over Paul Avenue and Maline Creek. Rather than extend the fill, it is proposed that the light rail tracks be elevated through this area. A similar situation exists south of Woodstock Road. After crossing Woodstock Road, at grade, the light rail alignment is again elevated over the ravine, rather than widening the high fill. The alignment continues basically at grade, but in a retained cut section under I-70, over Florissant Road, and under Natural Bridge Road.

Major engineering problems include:

1. Physical configuration of two high fill sections
2. Reconstruction of I-70 and Natural Bridge highway structures

3. Grade crossing at Woodstock Road
4. Constrained right-of-way along Redmond Avenue

Natural Bridge Road Bridge: The Natural Bridge Road structure itself will have to be modified, and the retaining walls pushed back to accommodate additional tracks.

Natural Bridge to Etzel Avenue

Basically the light rail alignment runs along the west side of the N & W tracks, at grade, without serious engineering problems from Natural Bridge to St. Charles Rock Road. However, after passing under St. Charles Rock Road the alignment is elevated to cross to the east side of the N & W tracks. This is necessary to avoid the industrial siding and clearance problems encountered at the TRRA overpass. The alignment returns to grade at the TRRA overpass and continues south to Page Avenue, where it crosses under the Page Avenue overpass and is then elevated all the way to Etzel Avenue.

Major engineering problems include:

1. Bridge modifications to Natural Bridge Road, St. Charles Rock Road, and Page Avenue bridges
2. Grade crossing at North Market Street
3. Physical constraints at the TRRA crossing and generally south of Page Avenue

Etzel Avenue to Kingshighway

South of Etzel Avenue the alignment continues on an elevated configuration, crossing over to the west side of the N & W tracks south of Etzel Avenue. The alignment continues on an elevated structure over Skinker Boulevard and returns to grade just south of Skinker. From Skinker south to Delmar, the alignment remains at grade, along the west side of the existing N & W tracks.

The alignment then passes under Delmar Boulevard and Delmar Station, using the vacant right-of-way west of the two active N & W tracks. No reconstruction is required at Delmar Boulevard.

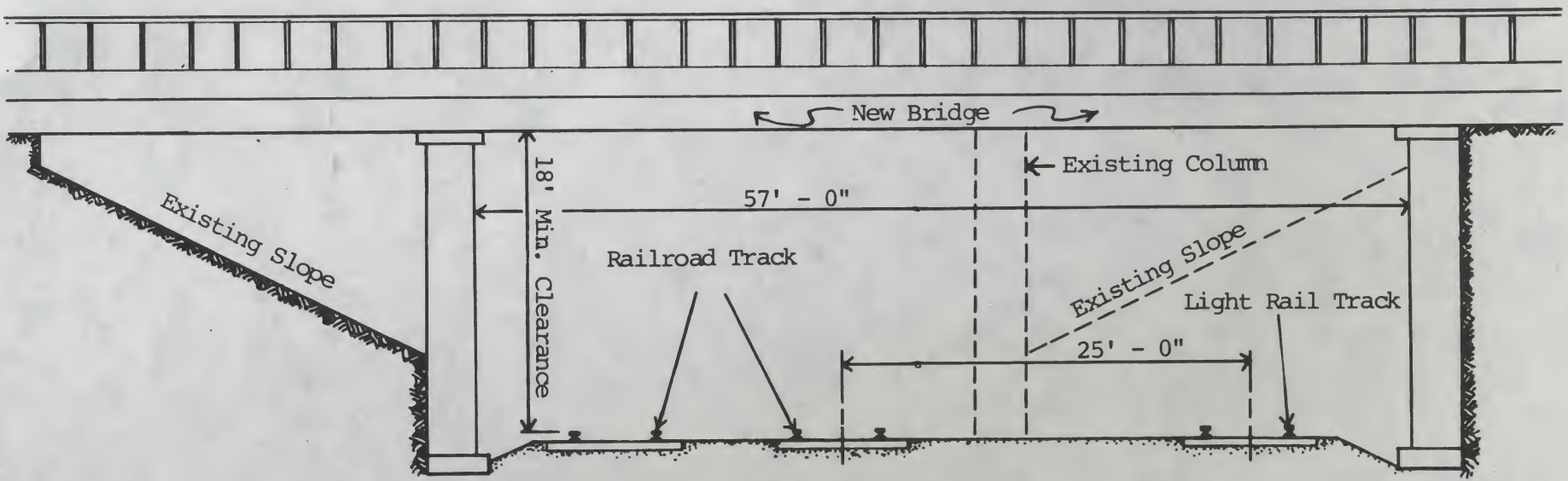
Delmar Station: The abandoned Delmar Station has been heavily vandalized, and would, therefore, be very expensive to renovate. Renovation could be considered, however, if other uses could be found for the structure.

The old, abandoned Delmar Station, which has been badly vandalized, could be renovated and incorporated into a light rail station. However, this is both unnecessary and expensive. Current plans provide for a standard light rail station at Delmar, with covered loading platforms, benches, stairs, and elevators. Renovation of the Delmar Station should be considered, provided other uses could be found for this large structure.

Leaving Delmar Station the alignment continues along the N & W tracks. However, the right-of-way is constrained, generally from Delmar to DeBaliviere, with the two existing N & W tracks located in the bottom of a 20-30 foot cut. These existing tracks are centered on the N & W right-of-way, which is only 56 feet wide. At the top of the cut, running parallel to the tracks, are 25-foot wide alleys. These alleys are 100 feet apart. The solution tentatively proposed is to widen the cut with retaining walls, reconstruct bridges at Waterman and Kingsbury Avenues, and construct the one light rail track alongside the two existing N & W tracks from Delmar to DeBaliviere. It would be possible to widen the cut sufficiently to install two light rail tracks, rather than one, but at great additional cost.

N & W Right-of-Way at DeBaliviere: The right-of-way between Delmar and DeBaliviere is severely constrained, with the tracks centered in a cut 56 feet wide and 20 to 30 feet deep.

Preliminary analysis suggests that it would be more feasible to construct only one light rail track and make provision for two-way operations with train control, as shown in Figure 16. The second light rail track could always be added at a later date, to



PROPOSED CROSS SECTION OF WATERMAN BLVD.

Figure 16

increase system capacity.

Past DeBaliviere the alignment turns eastward following along the south side of the N & W tracks through Forest Park to Kingshighway. The Union Boulevard overpass does not have to be reconstructed. The structure at DeBaliviere and the pedestrian overpass in Forest Park must be rebuilt to provide adequate horizontal clearance.

Figure 17 illustrates a typical section through Forest Park. Note the berms located along both sides of the existing railroad tracks. The construction of two light rail tracks will require low retaining walls to protect the berms and vegetation along both sides of the tracks, generally from Union Boulevard to Kingshighway.

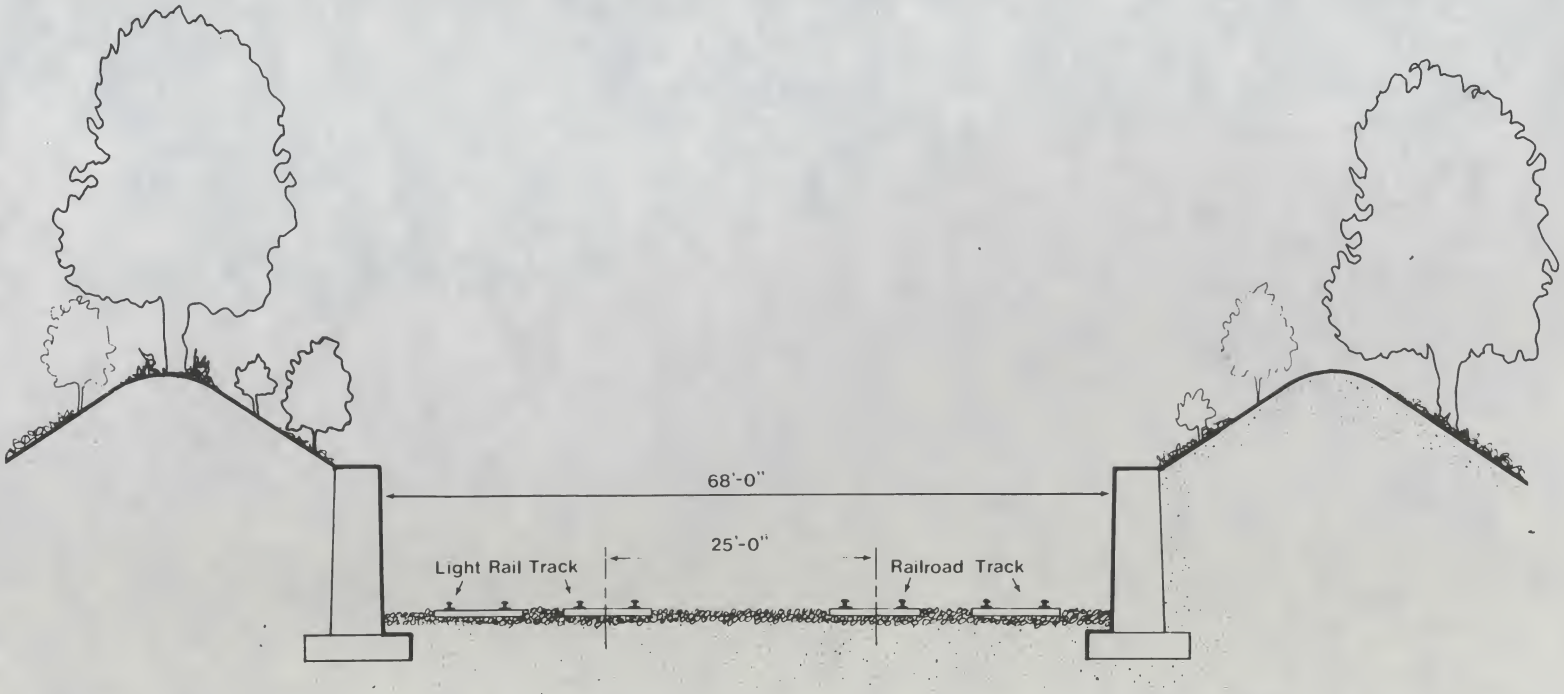
Significant engineering problems include:

1. Constrained right-of-way and narrow, deep cut from Delmar to DeBaliviere
2. Overpasses at DeBaliviere and footbridge in Forest Park need to be reconstructed
3. Low retaining wall along both sides of tracks from Union to Kingshighway to protect berms and vegetation

Kingshighway to Jefferson

At Kingshighway the alignment leaves Forest Park, tunnels under Kingshighway (a new tunnel immediately north of the existing N & W tunnel) and continues eastward under the Washington University Medical Complex and Euclid Avenue. Building supports and columns are generally spaced far enough apart to provide adequate clearance for light rail vehicles; however, a portion of the lower level of the existing parking structure must be eliminated and support columns rebuilt to provide for light rail operations and a possible station.

Existing Section In Forest Park



Proposed Section In Forest Park

Figure 17

The Euclid Avenue bridge must also be rebuilt to provide sufficient vertical and horizontal clearances.

Existing Kingshighway Tunnel: The existing tunnel is too narrow to admit both N & W tracks and light rail tracks. Therefore a new tunnel must be built immediately north of the current site.

Continuing east, the alignment quickly becomes elevated to avoid side-tracks, at-grade crossings, and constrained right-of-way. It continues elevated past Boyle Avenue and Sarah Street to Highway 40, where it returns to grade to cross under the Vandeventer Overpass. Next the alignment crosses Vandeventer on a new elevated structure and continues eastward in an aerial configuration except for brief drops to ground level to go under Spring Street and Grand Avenue.

The Vandeventer Overpass: The light rail alignment must drop to grade to cross under the Highway 40 overpass, basically at the same elevation as the existing railroad (N & W) tracks.

East of Grand the alignment again becomes elevated as far as Compton, where it returns to ground level to cross under Compton and continue on to Jefferson Avenue.

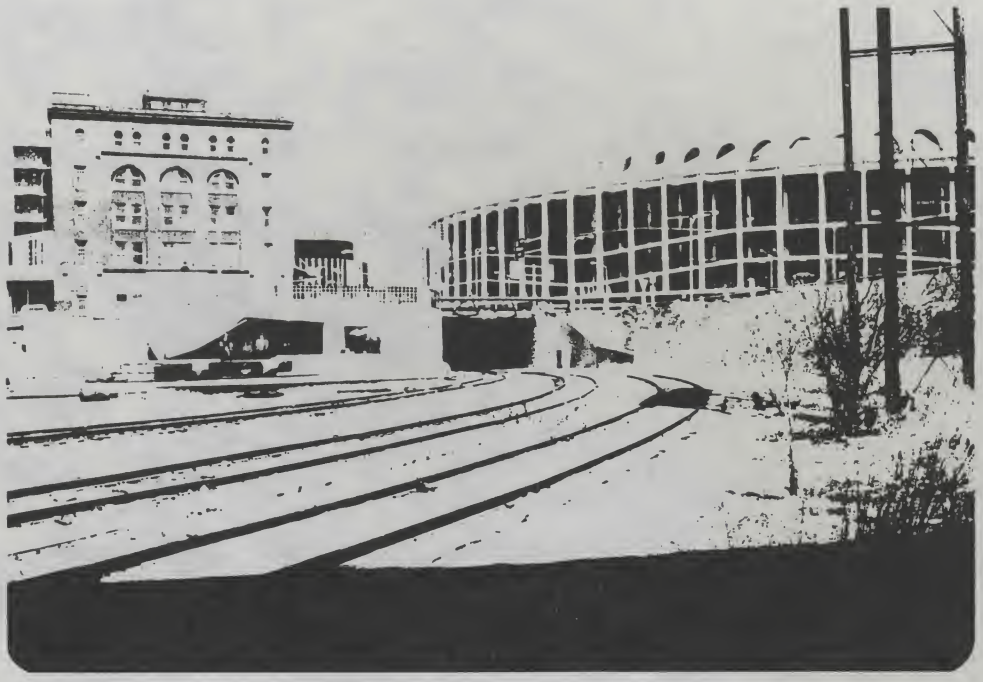
This section is, perhaps, one of the most constrained sections. The N & W right-of-way is limited, with two main line tracks, numerous side tracks, and buildings frequently constructed right up against the existing tracks. In some places, additional right-of-way will be needed, even using an elevated structure, in order to pass through without disrupting railroad operations.

Significant engineering problems include:

1. Tunnel under Kingshighway
2. Parking structure and bridge reconstruction at Euclid Avenue
3. Limited right-of-way
4. Numerous street crossings

Jefferson Avenue to Laclede's Landing

The original alignment proceeds east from Jefferson Avenue at grade on the north side of the existing tracks, (mostly under the Highway 40 viaduct) until it swings into the TRRA tunnel entrance under Eighth and Spruce Streets. From here it runs north in the tunnel, connecting with the Old Post Office at 8th and Locust, turning east under Washington Avenue, and surfacing on the Eads Bridge west approach. Minor repairs are necessary in the tunnel, although the tunnel itself is in relatively good condition. There are isolated instances where brick has fallen from the overhead arches; this, of course, will have to be repaired, but the problem



Abandoned TRRA Tunnel under Downtown St. Louis: The light rail alignment will use the existing TRRA tunnel connecting 8th and Spruce Streets with the Eads Bridge west approach.

is neither serious nor widespread. There is some water seepage into the tunnel, but it appears to come from broken sewers. The tunnel's own drainage system will also have to be cleaned and repaired. Vertical and horizontal clearances are adequate for light rail operation in the abandoned tunnel.

The only major engineering problem involves:

1. The construction of passenger access to street level at stations

Laclede's Landing to East St. Louis

From a proposed station at Laclede's Landing, the alignment continues eastward across the Eads Bridge into Illinois using the lower, or rail, level of the bridge. According to a recent study[1] the Eads Bridge will require significant repair such as: painting and sandblasting of main spans, repairs to structural steel, and

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[1]Howard, Needles, Tammen, & Bergendoff, EADS BRIDGE OVER THE MISSISSIPPI RIVER, BRIDGE INSPECTION AND ENGINEERING REPORT, November 1979.

major repairs to the auto deck. New elevated approaches to the Eads Bridge would be constructed to replace the existing bridge approaches.

Eads Bridge: The light rail alignment will use the lower (rail) deck of the Eads Bridge, providing needed repairs are made to the bridge.

After leaving the bridge, the alignment continues eastward at-grade under I-55/70 to a proposed terminal station in East St. Louis between Fifth and Sixth Streets. One section of elevated track would be needed, however, to cross over the ICS railroad tracks.

Significant engineering problems include:

1. Repairs to Eads Bridge
2. New approaches to Eads Bridge
3. Grade crossing at Main and Fourth Streets in East St. Louis
4. Elevated structure over ICS railroad

Branch Line to Northland Shopping Center

A proposed branch would leave the main line in the vicinity of Paul Avenue (Maline Creek in Ferguson, just south of Florissant Boulevard). This branch alignment generally follows the abandoned St. Louis Belt and Terminal Railway right-of-way, under Bermuda

Avenue eastward along Maline Creek, under the N & W tracks and along Ferguson Boulevard and the N & W tracks to a terminal station in the Northland Shopping Center. The alignment is mostly at grade, except for the eastern section which is elevated to cross West Florissant Avenue and enter the shopping center.

The only significant engineering problem involves the reconstruction of the Bermuda Avenue underpass.

Forest Park Alignment

An alternate alignment studied involved the use of the existing median in Forest Park Boulevard for light rail. The alternate, Forest Park, alignment is identical to the original or N & W alignment from Brown Campus (I-270) to a point just west of Kingshighway. At this point, west of Kingshighway and immediately north of Forest Park Parkway, the alternate alignment turns east with a new tunnel under Kingshighway and Euclid Avenue. East of Euclid Avenue the alignment surfaces in the median of Forest Park Parkway and continues at-grade as far as Grand Avenue, where an elevated structure is proposed over Grand Avenue.

Forest Park Parkway at Euclid, looking west: The alternate alignment surfaces in the wide median on Forest Park Parkway and comes into downtown St. Louis basically at-grade.

East of Grand the alignment returns to the surface, crossing Compton and Jefferson Avenues, and continuing to 9th Street along Market Street. At 9th Street the alignment enters a short tunnel section which joins the abandoned TRRA railroad tunnel under 8th Street. At this point the alignment continues over Eads Bridge to East St. Louis following the same path as the original alignment.

The alignment described above is basically a surface or at-grade operation along existing streets, and was used for estimating costs and patronage throughout this study. There are several variations on this alignment which warrant further evaluation during preliminary engineering. These variations include:

1. Elevated along the median of Forest Park Parkway and Market Street from east of Euclid to approximately 9th and Market where it enters the tunnel section.
2. Cut-and-cover from east of Euclid in the median of Forest Park Parkway to a point east of Boyle Avenue. Then surface to the 9th and Market tunnel section in downtown St. Louis.
3. Cut-and-cover from east of Euclid in the median of Forest Park Parkway and in Market Street to the tunnel section in downtown St. Louis.

Major engineering problems on the alternate (surface) alignment include:

1. Tunnel under Kingshighway, similar to Kingshighway tunnel for N & W alignment, but longer
2. Interference with traffic flow (pedestrian and auto) along Forest Park Parkway and Market Street, especially at heavily travelled intersections

Figures 18, 19, 20, and 21 illustrate the more significant impacts of at-grade light rail operations along Forest Park Parkway and Market Street. On Forest Park Parkway, the light rail tracks can be constructed within the existing median, which is 24 feet wide, without difficulty. Of course the small trees and statuary must be removed. The problems arise at intersections, where station loading platforms must be built and left-turn lanes are needed. Figure 18 shows a suggested solution to this problem, which involves:

1. Removal of curb parking
2. Widening of median to accommodate far-side loading platforms
3. Shifting of traffic lanes and re-marking as shown
4. Signalization with preemption devices for light rail operation.

Figure 18 is typical of all the intersections along Forest Park Parkway.

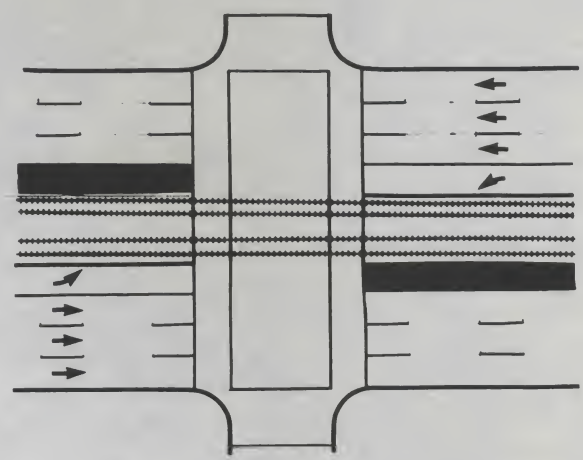


Figure 18: Typical Forest Park Parkway intersection treatment

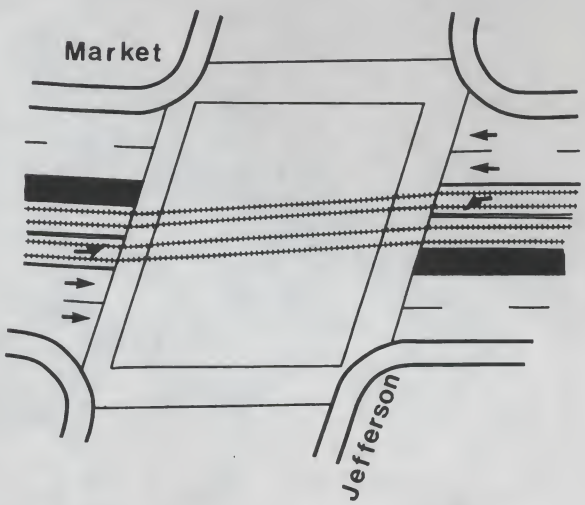


Figure 19: Proposed intersection layout on Market Street and Jefferson

Along Market Street (Figure 19) where there is no raised median,

the problem is somewhat more acute. For example, Figure 19 illustrates a suggested solution for at-grade or surface light rail operation at the Market/Jefferson intersection. The proposal includes:

1. Removal of all curb parking
2. Construction of far-side loading platforms
3. Shifting and re-marking traffic lanes--reduction of through-travel lanes from three to two in each direction on Market Street approach
4. Permitting signalized left-turn movements over light rail tracks as shown
5. Signalization with preemption equipment for light rail

At Market and Tucker Boulevard (12th), the proposed solution is identical to that proposed for Market and Jefferson. Figure 20 illustrates the intersection functioning, lane markings, and location of the light rail tracks and loading platforms.

The final illustration, Figure 21 (next page), depicts the treatment proposed for Market Street and 9th--the point where the light rail tracks start descending into the TRRA tunnel. Again, the following actions will be necessary:

1. Removal of all curb parking

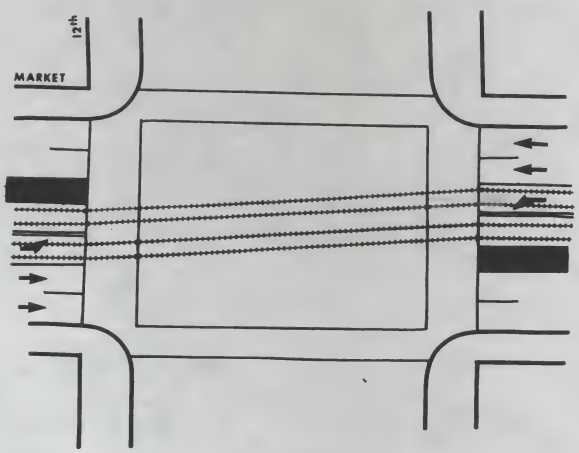


Figure 20: Proposed solution to light rail in street at Market/ Tucker (12th) intersection

2. No loading platforms
3. Shifting and re-marking traffic lanes--two in each direction
4. Signalized left turn, which operates on separate phase from light rail
5. Signalization with preemption for light rail operations

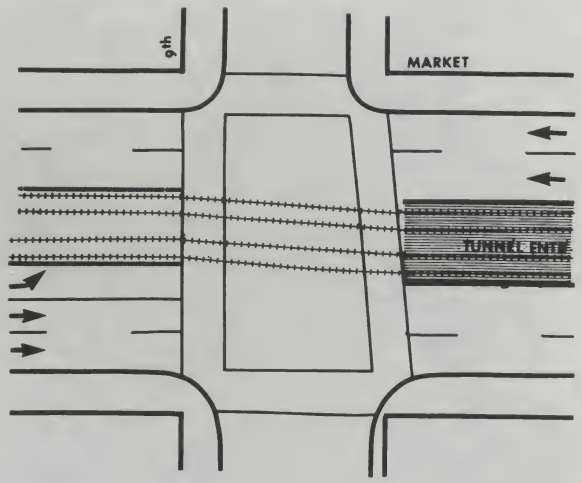
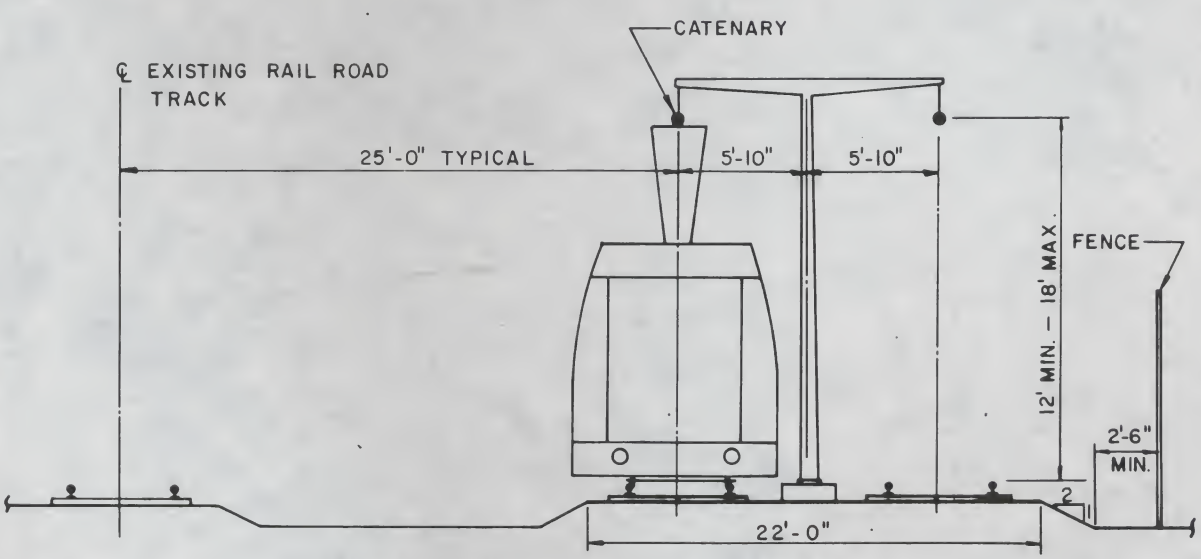


Figure 21: Proposed solution to light rail operations in Market Street at tunnel entrance

Typical Sections

Typical sections were developed for the more common areas found along the proposed light rail alignment.

At-Grade: Figure 22: Most of the alignment will be at grade,

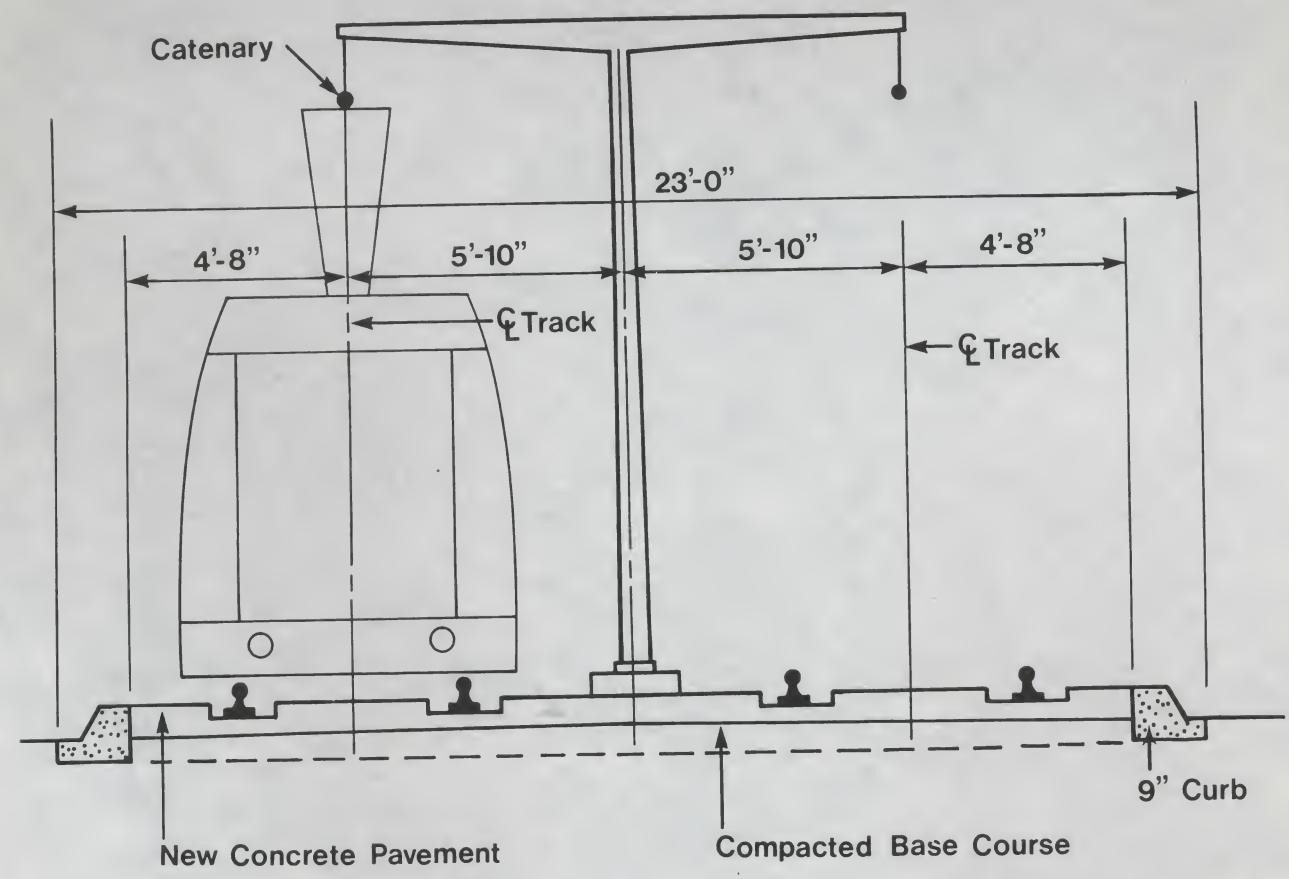


TYPICAL- SECTION – AT GRADE

Figure 22

parallel to existing railroad tracks, to minimize construction costs and disruption to neighborhoods. The at-grade section provides for a 25-foot separation, center to center, between the railroad and light rail tracks. About 22 feet is required for full two-way light rail operations, plus additional space for side clearances and fencing as required. Note that overhead catenary is supported by poles located midway between the light rail tracks. The catenary can be between 12 and 18 feet above the top of the tracks.

At Grade in Street Right-of-Way: Figure 23: Figure 23 shows the possible use of light rail operating at grade along existing

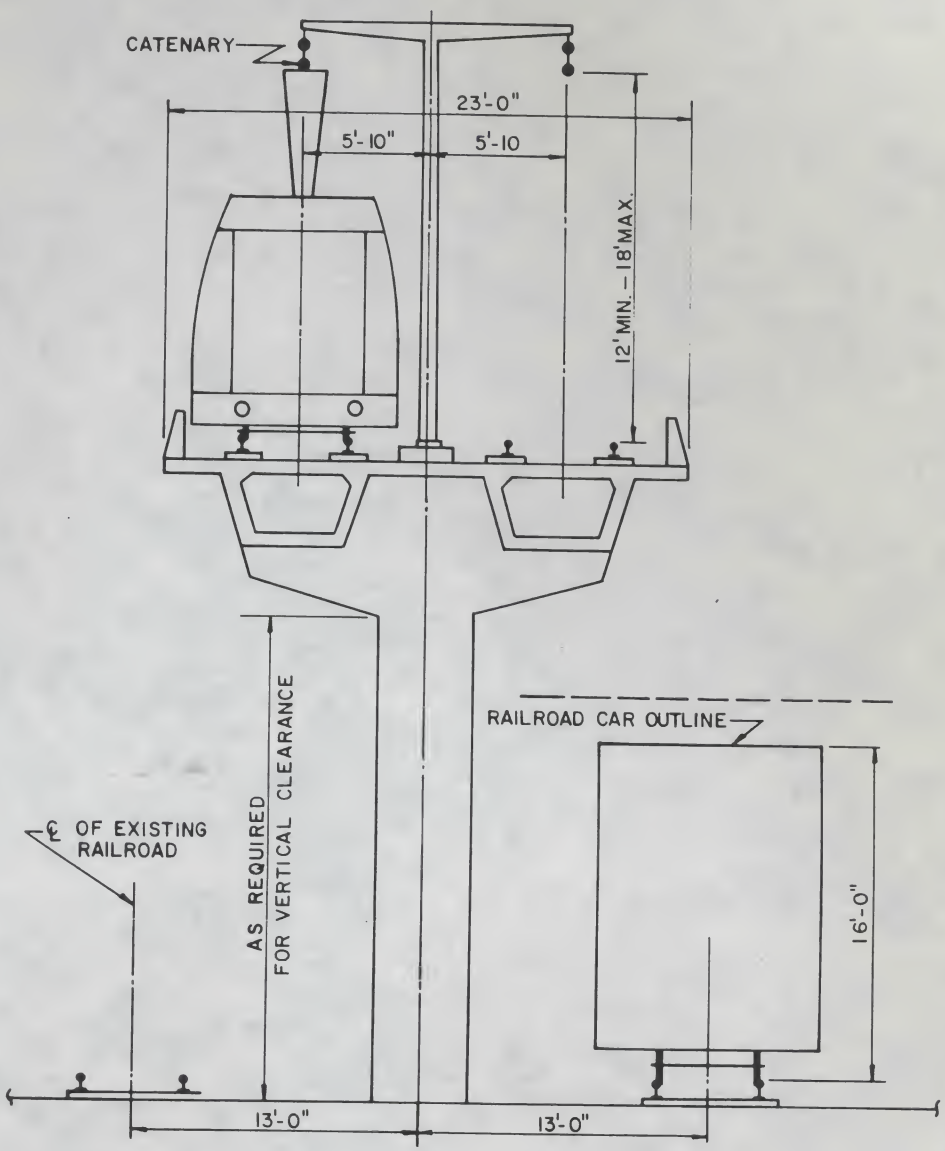


TYPICAL SECTION AT GRADE IN STREET
Figure 23

streets, such as within the median of Forest Park Parkway (the alternate Forest Park alignment). In this case the light rail could be protected

from normal auto traffic by a raised curb as shown in Figure 23. This would discourage auto and truck traffic along the light rail tracks. An acceptable alternate method would be to maintain the tracks at the same grade as the street but to discourage auto traffic through the use of pavement markings and rough pavement sections, such as cobblestone.

Elevated Between Railroad Tracks: Figure 24: Some segments of the light rail alignment must be elevated because of limited right-of-way and because of side tracks which should not be crossed at grade. The typical section illustrated provides for construction of an elevated structure to support the light rail tracks above the normal railroad operations. The required separation between light rail and railroad tracks is 13 feet,

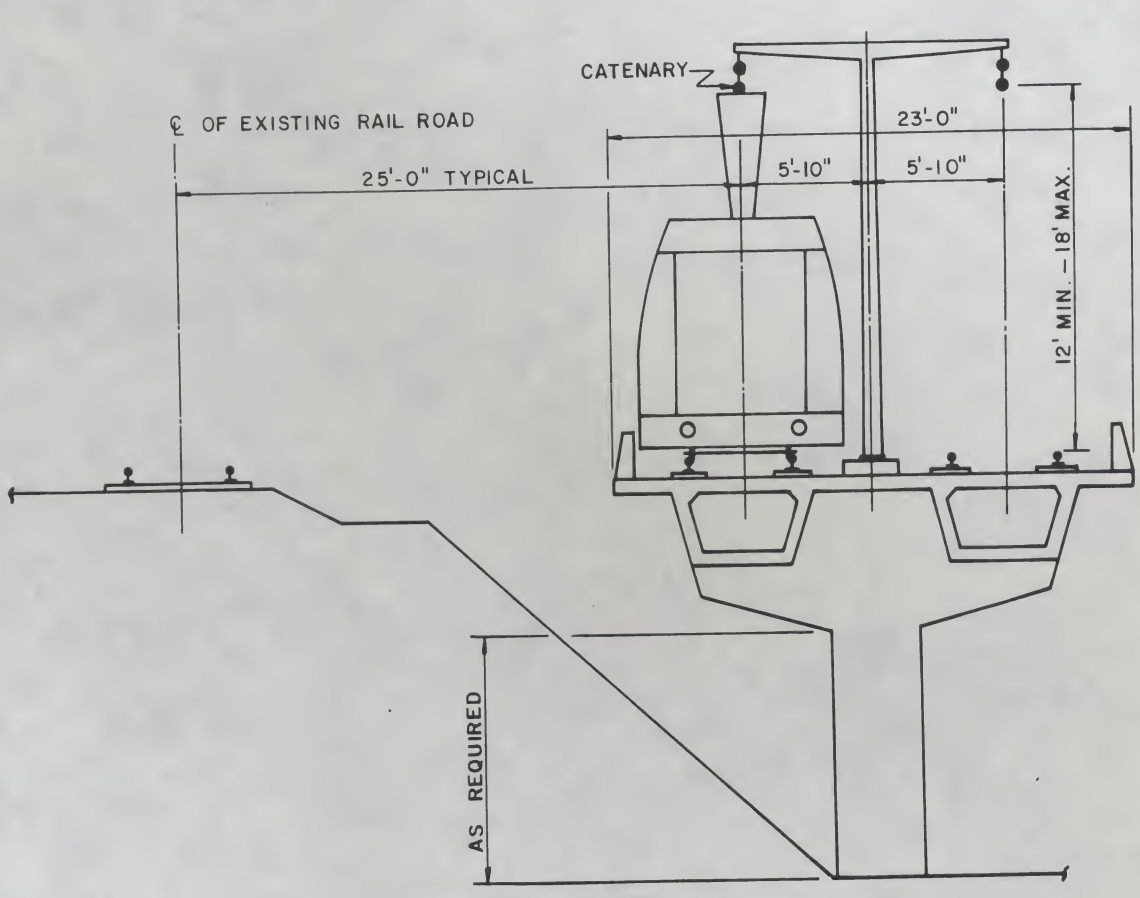


TYPICAL ELEVATED SECTION BETWEEN RAILROAD TRACKS

Figure 24

center to center, with the height of the structure varying to provide adequate vertical clearance.

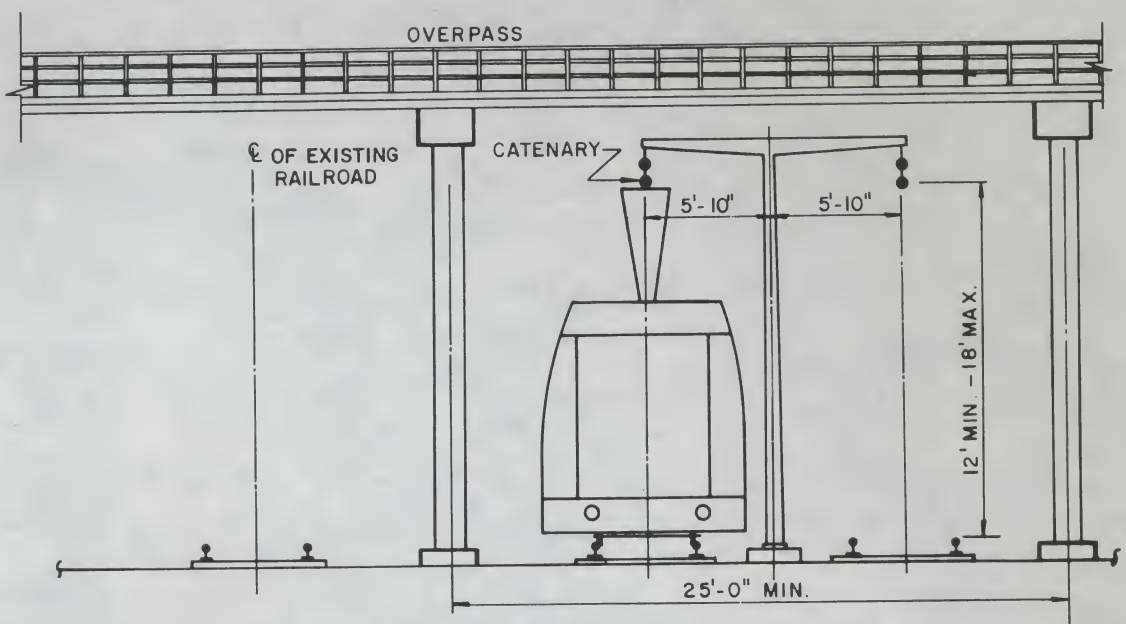
Elevated at Ravine: Figure 25: A significant section of the N & W trackage is in sections of heavy fills or ravines. Rather than widen the fills, it is proposed that the light rail be constructed on an elevated structure as shown in Figure 25. The



TYPICAL ELEVATED SECTION AT RAVINE
Figure 25

environmental impact of constructing an elevated structure should not be as severe as that of widening the fills. Of course, consideration sould be given to extending the fill sections where feasible, to help reduce construction costs.

Under Existing Bridge: Figures 26 and 27: The two typical sections illustrate the possible methods of constructing light rail under existing structures. Type 1, Figure 26, provides for a minimum of 25 feet between bridge supports, permitting two light rail tracks to lie side by side, without intervening bridge supports. Note that Type 1 also provides for overhead catenary supported by a separate pole between the two light rail tracks.

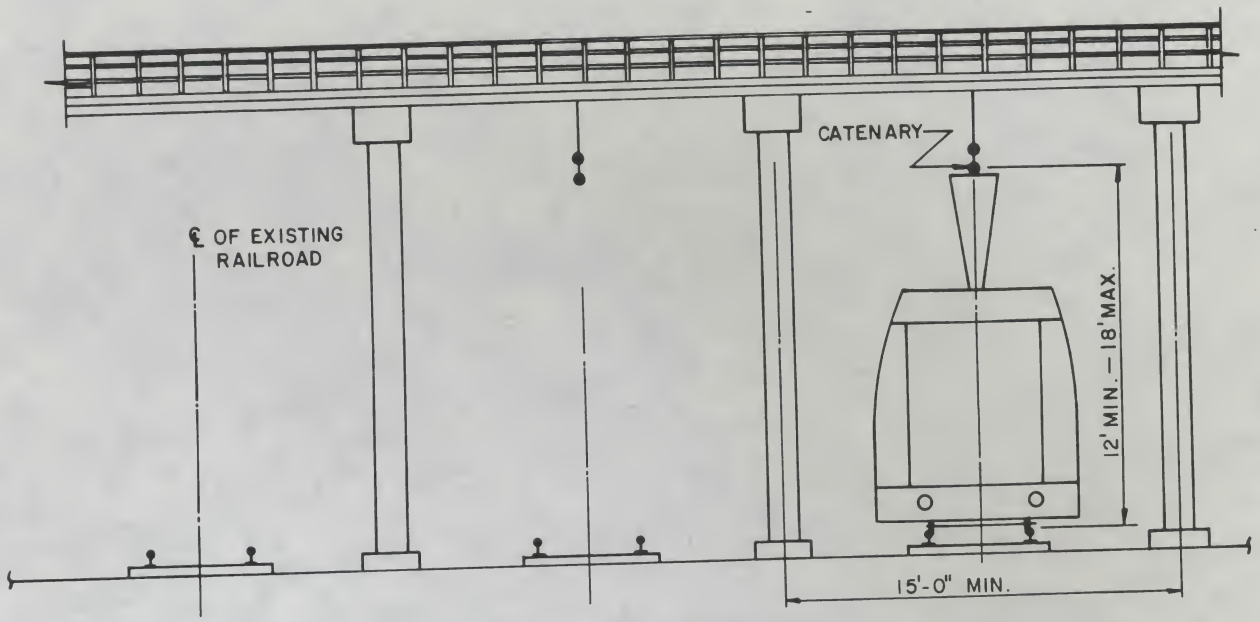


TYPICAL SECTION
UNDER EXISTING BRIDGE STRUCTURE

(TYPE 1)

Figure 26

Type 2, Figure 27 covers the situation where it is impractical to obtain the full 25-foot horizontal clearance for two tracks. A minimum of 15 feet of horizontal clearance is shown, which provides clearance for only one light rail track. Note also an alternate method of supporting the overhead catenary.

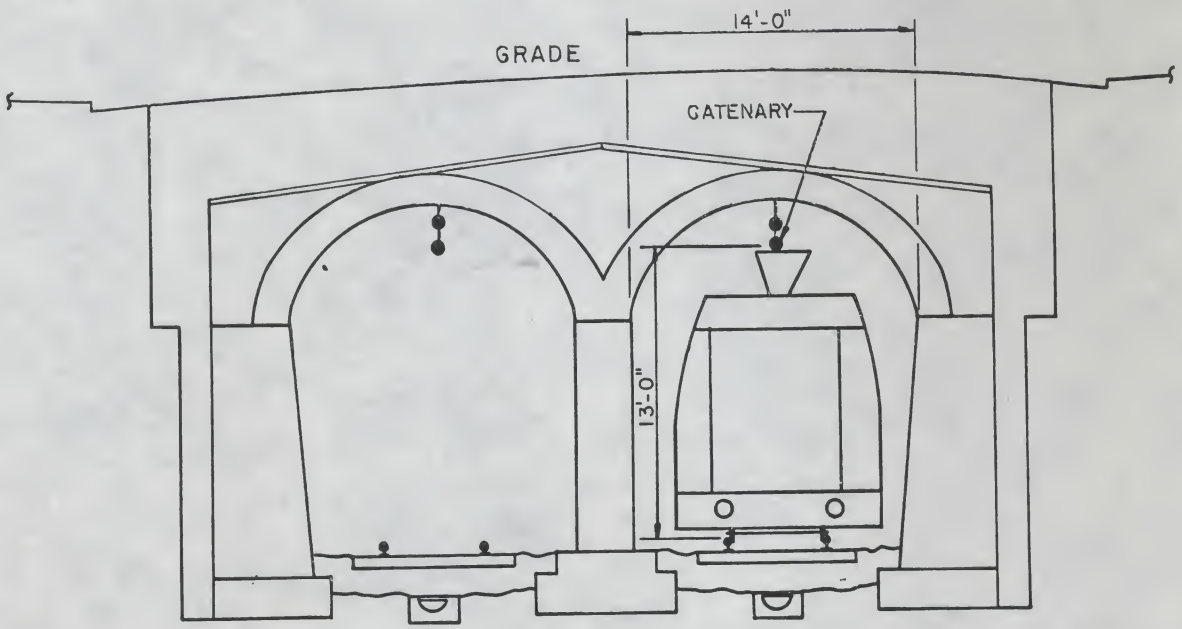


TYPICAL SECTION
UNDER EXISTING BRIDGE STRUCTURE

(TYPE 2)

Figure 27

Existing Tunnel: Figure 28: The existing abandoned TRRA tunnel is depicted in Figure 28. It has adequate vertical and norizontal



TYPICAL SECTION EXISTING TUNNEL

Figure 28

clearance for light rail. The catenary will have to be lowered to around 13 feet throughout the tunnel, however. The tunnel, with minor reconstruction, is adequate for light rail operation with the cleaning of the drainage system, the installation of ties, ballast, and tracks, and the installation of the overhead catenary attached to the top of the tunnel arch.

Power Distribution System

The traction power network will consist of the following major elements:

*Traction power substations located at regular intervals throughout the system, each receiving Union Electric a.c. service and converting it into 650 volt d.c. supply

*A supply circuit between the substations and the transit vehicles consisting of the overhead pick-up system, the vehicle, and the running rails

Preliminary substation locations and ratings are determined considering construction practicality, an allowable line voltage drop under normal operating conditions of 25% at any train, and the capacity to support three-car trains running at ten-minute headways. The traction power network resulting from our study is also shown in Figure 29 and contains 18 substations, 15 of which are located at passenger stations; one is located at the storage and maintenance yard, and the remaining two are located between passenger stations.

The final determination of the substation's location within the passenger station complex will depend on station platform configuration, relationship to other fixed facilities, such as the

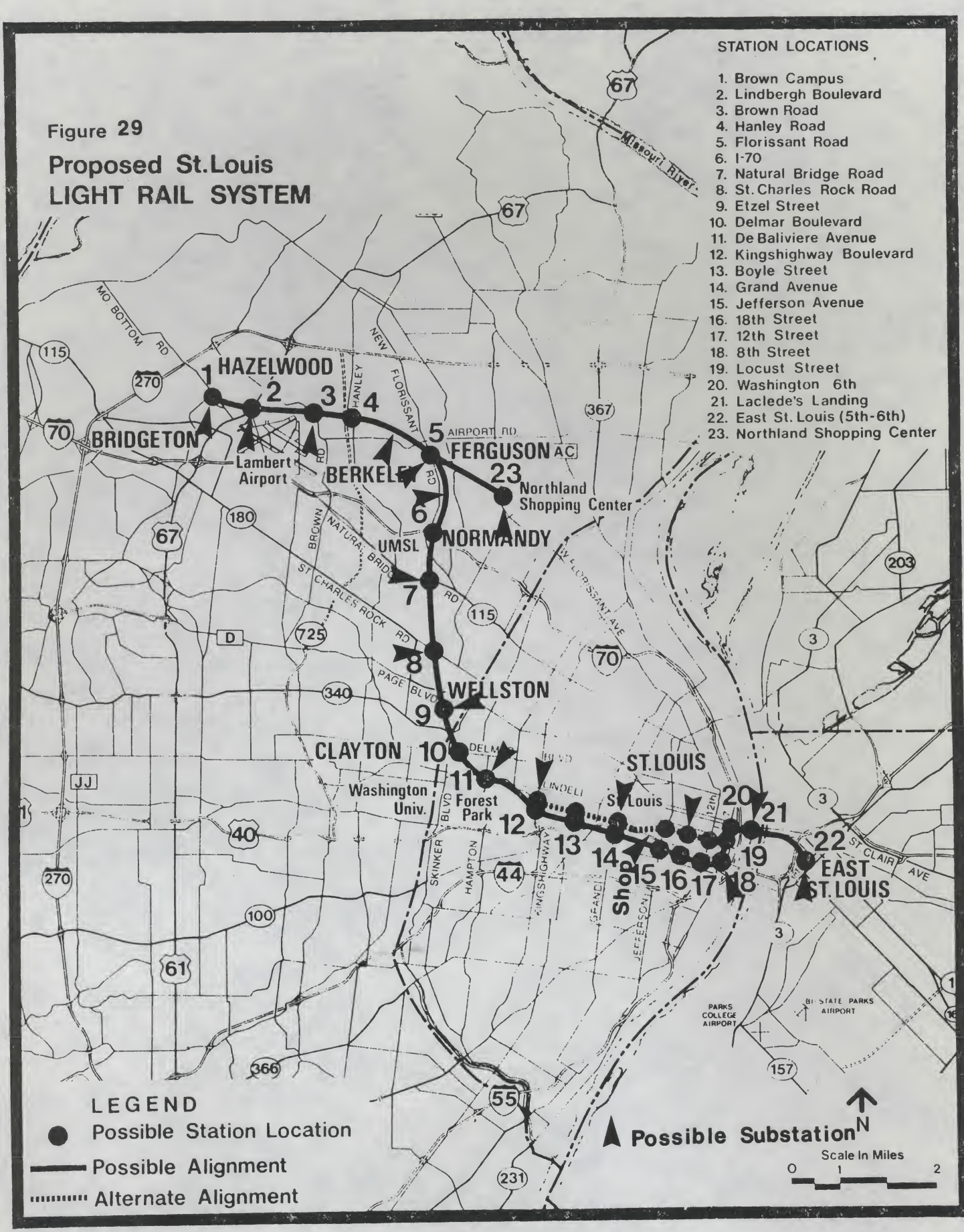


Figure 29
Proposed St.Louis
LIGHT RAIL SYSTEM
STATION LOCATIONS
1. Brown Campus
2. Lindbergh Boulevard
3. Brown Road
4. Hanley Road
5. Florissant Road
6. I-70
7. Natural Bridge Road
8. St. Charles Rock Road
9. Etzel Street
10. Delmar Boulevard
11. De Baliviere Avenue
12. Kingshighway Boulevard
13. Boyle Street
14. Grand Avenue
15. Jefferson Avenue
16. 18th Street
17. 12th Street
18. 8th Street
19. Locust Street
20. Washington 6th
21. Laclede's Landing
22. East St. Louis (5th-6th)
23. Northland Shopping Center
HAZELWOOD
BRIDGETON
Lambert Airport
FERGUSON
BERKELEY
Northland Shopping Center
UMSL
NORMANDY
WELLSTON
CLAYTON
Washington Univ.
Forest Park
ST.LOUIS
St Louis
EAST ST. LOUIS
Missouri River
MO BOTTOM RD
HANLEY RD
NEW FLORISSANT RD
AIRPORT RD
BROWN RD
NATURAL BRIDGE RD
ST CHARLES ROCK RD
PAGE BLVD
DELMAR BLVD
LINDELL BLVD
SKINKER BLVD
HAMPTON
KINGSHIGHWAY
GRAND
JEFFERSON
ST CLAIR AVE
PARKS COLLEGE AIRPORT
BI-STATE PARKS AIRPORT
LEGEND
Possible Station Location
Possible Alignment
Alternate Alignment
Possible Substation
N
Scale In Miles
0 1 2

adjacent railroad tracks, whether the station is at-grade, aerial, or in tunnel, and specific site access conditions. These site conditions will govern the substation location at each station; however, some general statements can be made at this time:

1. The substation should be located to minimize connection costs to Union Electric facilities.
2. At aerial stations, the substation should be located directly under the elevated structure.
3. At relatively level at-grade stations, the substation should be located adjacent to the tracks, such as in an unobtrusive corner of a park-and-ride lot, and where disruption to existing utilities or other facilities is minimized.
4. At tunnel stations, the substation should be located at or near track level, preferably in a separate room or enclosure. Access from the track or from a street above should be assured to provide for delivery of replacement components if necessary.
5. For those few substations not located at passenger stations, a plot of land should be acquired which is adjacent to or on the right-of-way, large enough to accommodate the substation, and accessible.
6. In any event, the substation complex must be secured against unauthorized or accidental entry.

It is recommended that each substation be rated at 3000 kw, comprised of double-ended rectifier units of 1500 kw each. This concept allows for sufficient capacity for continued operation should

one of the 1500 kw units be shut down for maintenance, or should power be lost due to malfunction.

Electrification costs are estimated at $850,000 per substation, and $80,000 per mile for catenary, poles, and miscellaneous hardware, for a total of $14.82 million.

Storage and Maintenance Facilities

A storage and maintenance facility to support a 40-car system would require nine acres as a bare minimum, and fifteen acres to provide desirable expansion potential. The facility would incorporate maintenance and cleaning equipment to support the vehicles, storage space for both vehicles and replacement track, and office space, parking, and support facilities for employees assigned to the site.

Eight sites were evaluated on the following criteria:

15-acre minimum lot size

Prime industrial potential

Compatibility with surrounding land uses

Access

Topography

Land cost

Public acceptance

The site selected is an 18-acre lot bounded by Ewing Avenue on the west, Scott Avenue on the north, Jefferson Avenue on the east, and the light rail alignment on the south, and presently occupied by the City of St. Louis car tow lot. Since the lot is larger than necessary and is ideally shaped, it is possible that the storage and maintenance facility could be built without evicting the current tenants. Because the lot was originally a rail yard

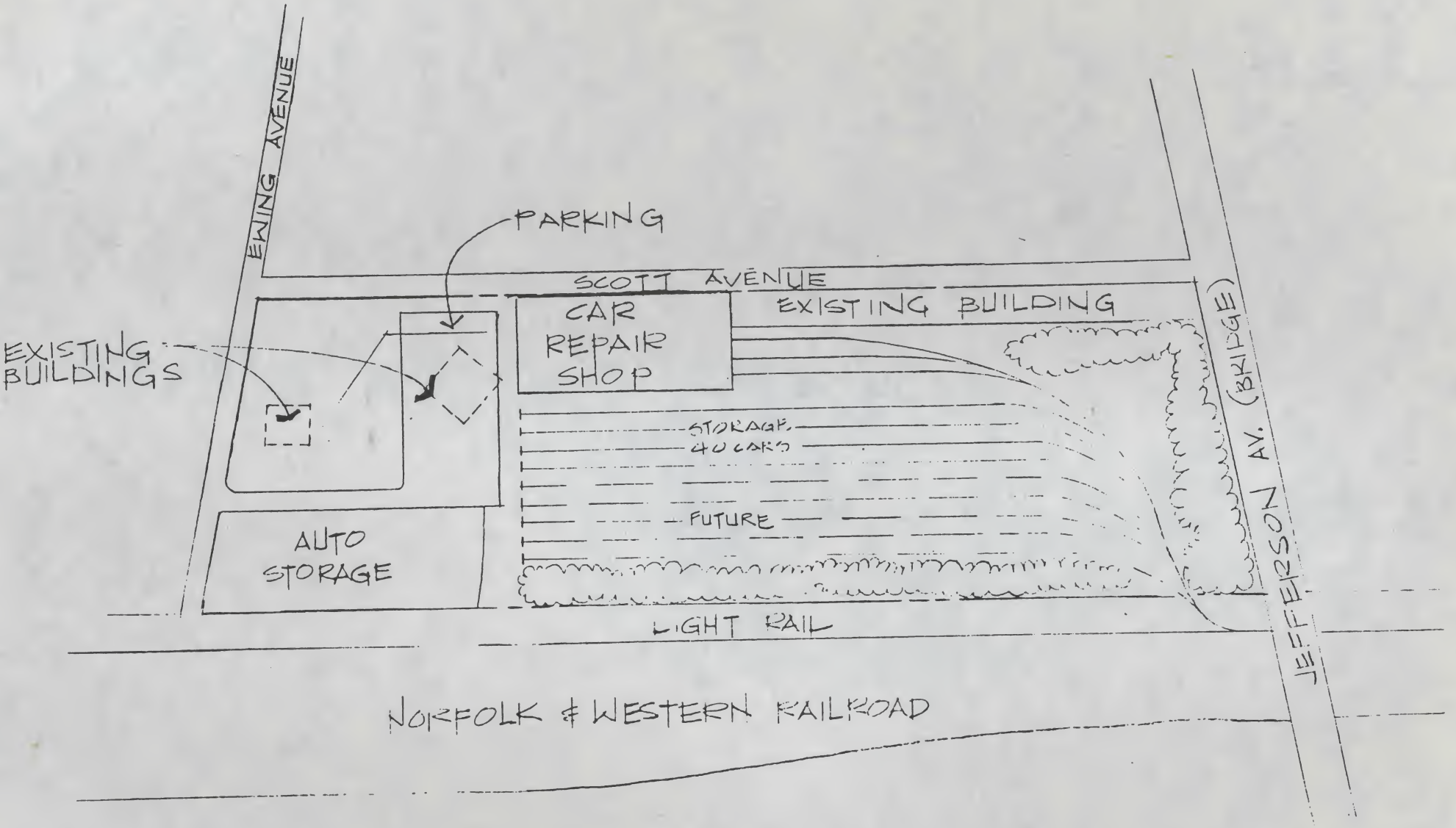


Figure 30

PROPOSED MAINTENANCE FACILITY
JEFFERSON AVENUE SITE III

SCALE: 1" = 200'

and is located in a basically industrial area, impact on neighboring properties would be minimal. Fleming Corporation estimates acquisition costs at $1,000,000.

St. Louis City Tow Lot: Note industrial surroundings and proximity to the track

Summary

The engineering assessment of the proposed light rail alignment does not indicate any insurmountable problems. There are some significant problems which will require further detailed engineering studies to fully satisfy the concerns of the Norfolk & Western (N & W) Railroad. This is understandable and was expected. In essence the assessment shows that, from an engineering point of view, the proposed light rail alignment is feasible.

The twenty-two (22) mile system can be constructed generally along the N & W right-of-way, without causing any degradation to normal railroad operations.

Table 4 summarizes the system mileage by type, either at-grade, at-grade retained, elevated, subway, or on the Eads Bridge. Note that over half of the alignment can be constructed at grade, the least costly configuration. Less than a mile of subway or underground construction would be required. Finally, the alignment would make use of up to 1.4 miles of the abandoned TRRA railroad tunnel and the Eads Bridge.

Table 4
SYSTEM MILEAGE
St. Louis Light Rail System

Type of Construction	Original Alignment (N & W) Miles	Original Alignment (N & W) Percent	Alternate Alignment (Market Street) Miles	Alternate Alignment (Market Street) Percent
At-grade	12.3	56	13.3	61
At-grade (retained)	2.4	11	2.4	11
Elevated	5.5	25	4.1	19
Subway	0.4	2	0.7	3
Eads Bridge/Tunnel	1.4	6	1.2	6
TOTAL	22.0	100	21.7	100

IMPACT OF THE SYSTEM

Aesthetic, Historical, and Environmental Impact

Placing the light rail alignment primarily on existing railroad right-of-way tends to minimize environmental impact, first because the land is already used for rail transportation and the system occasions no change, and second because the neighbors are generally industrial facilities, facilities that located where they are, primarily to take advantage of access to the railroad. Nevertheless, since the existing tracks are not currently heavily used, increasing rail traffic in the corridor has some potential for disruption. This section summarizes the potential impact (adverse and beneficial) the light rail system may have on its surroundings. The light rail vehicles, being electrically powered, do not emit air pollutants, so the principal concerns are noise and visual impact.

Brown Campus to Lindbergh Boulevard: This segment of the corridor is characterized by large expanses of open space on both sides of the alignment. To the east lie a number of industrial facilities, while land to the west is largely undeveloped. Noise, then, is not expected to be a problem, due to the absence of sensitive receptors and the distance of most neighboring facilities from the track. In addition, the proximity of the airport means that ambient noise levels are extremely high, and the light rail system would not contribute appreciably. The only sensitive receptors in the sector are the residences on Robertson, which lie several hundred feet from the alignment, this distance effectively screening the houses from light rail noise.

Lindbergh Boulevard to Hanley Road: This area is occupied

principally by transportation-related industrial facilities, particularly Lambert International Airport and McDonnell-Douglas Corporation. Ambient noise levels are high because of the airport, and the absence of sensitive receptors means that noise will not be a particular problem.

Hanley Road to Florissant Road in Ferguson: Suburban, single-family residences line both sides of the right-of-way from Hanley Road to Airport Road, except for mixtures of small, light industrial and commercial tracts around Wabash and Airport Roads and extending north from downtown Ferguson. Airport School sits nearly astride the alignment at Airport Road. This is the beginning of a stretch with the potential for serious noise problems; despite the fact that this part of the right-of-way lies in a cut, the gentle slope of the sides of that cut will make it difficult to shield the surrounding residences and the school from rail-generated noise.

Florissant Road to I-70: Both sides of this section are also lined by residential property. Many of these homes are very close to the corridor, with their yards abutting the right-of-way. South of the right-of-way, along Redmond Street, in fact fifteen single-

Fifteen houses along Redmond Street may have to be acquired, as they are so close to the track

family units lie so close to the right-of-way that they may have to be acquired. Redmond Street itself may have to be absorbed. In addition, a number of these houses are elevated above, or depressed below, the grade of the proposed light rail line, giving residents an unobstructed view of the tracks, and offering little opportunity for reducing noise.

I-70 to Natural Bridge: This area is basically institutional, including part of the University of Missouri-St. Louis (UMSL) and several hospitals. As a result, the landscape is relatively open, and sensitive receptors are set well back from the tracks, minimizing noise or visual impact. Just north of Florissant Road, three multiple-family structures and several single-family homes lie very close to the right-of-way, making it very difficult to mitigate adverse effects. There are a number of homes on the side of the right-of-way between Florissant and Natural Bridge Roads that, while farther from the track than those mentioned above, are still too close to totally avoid rail noise.

Natural Bridge Road to St. Charles Rock Road: This section includes a number of institutions, including part of the UMSL campus, Marillac Seminary, St. Vincent County Park, Glen Echo Country Club, and St. Peter's Cemetery. The system would have only moderate noise/visual impact, as these institutions are set well back from the tracks and protected from noise by the distance. Immediately north of St. Charles Rock Road, the landscape changes abruptly to industrial and commercial property with a few residences. Noise impact would be minimal in this basically industrial sector.

St. Charles Rock Road to Delmar Boulevard: South of St. Charles Rock Road the right-of-way is bordered on both sides by large industrial

tracts such as the Central Hardware lumber warehouse, the Wagner Electric factory, the General Electric factory, the Bardenheier wine facility, and others. Since there are few sensitive receptors in this industrial corridor, neither noise nor visual disruption will be significant.

The light rail system would use the old Delmar station, which is currently badly deteriorated, and will require extensive rehabilitation. Rehabilitating the station would have a positive aesthetic effect by converting a deteriorating eyesore into an attractive, safe, and useful property.

Delmar Boulevard to Kingshighway: The area bordering the right-of-way from Delmar to Union Boulevards is primarily residential, consisting of large, single- and multiple-family residences built very close together on small lots. There is considerable redevelopment activity around the edge of Forest Park and DeBaliviere Place.

If the light rail system is constructed at grade through this section, it can utilize existing ravine banks to minimize noise and visual impact. If it is elevated, it will be on a level with neighboring homes, with nothing to protect them from noise or from visual impact. From Union to Kingshighway Boulevards, the right-of-way crosses through Forest Park, at grade, but shielded from view by high, grassy, earthen berms on both sides.

Kingshighway Boulevard to the Downtown TRRA Tunnel: In this sector the right-of-way passes under the large medical complex at Kingshighway and then rises to elevated structure to avoid side tracks in an extensive switching area. It stays elevated past Grand to almost Jefferson except where it must drop to ground level to

cross under highway overpasses. This area is principally industrial, and the consequent lack of sensitive receptors will minimize both noise and visual impact.

The alternate alignment is bordered by mixed office (largely medical), commercial, and residential properties as far as Newstead, with four-family flats and large apartment houses/ condominiums filling the blocks from Newstead to Boyle. From Boyle to Grand the area is mainly light industrial, with service commercial facilities located at major intersections. The segment of the corridor that would be most affected is that between Euclid and Boyle, where a combination of trees and grass in the boulevard median, stylish older residential units, and well-landscaped offices and apartments all contribute to an aesthetically pleasing environment. Use of the median for light rail tracks either elevated or at-grade, would disturb existing visual patterns and would increase noise levels in a basically residential area.

From Grand to Jefferson the alternate alignment passes through a mixture of multiple family housing, educational institutions, and light industrial/service commercial. The impact in this area is limited largely to the visual impact of the structure carrying the light rail track over Grand Boulevard, as noise will not be a significant factor due to high ambient noise levels from adjacent U.S. 40.

The last segment of the alternate alignment is a mixture of governmental, commercial, and office properties, along with the open space provided by the Gateway Mall and the proposed development around Union Station and the Milles fountain. If the alignment

were elevated in this area it would damage its scale and symmetry, destroying the visual relationship between the architectural elements. As a result, there would be significant adverse visual/aesthetic impacts generated by an elevated light rail system at this location.

8th Street Tunnel to Laclede's Landing: Environmental impact is minimal over this stretch, simply because the tunnel isolates the vehicles from neighboring structures. Nor should the system damage the tunnel itself or surrounding building foundations, as the tunnel was designed for rail use. Some connections between the tunnel and the street will be necessary; however, since the precise locations of access points have not been selected, it is impossible to estimate at this time the impact of construction on aesthetic or historic areas downtown.

Laclede's Landing to East St. Louis: Impact on the Eads Bridge itself will basically be positive, as the bridge will require extensive renovation to ensure safety on the proposed system. Major alternations will not be necessary, as the current bridge structure includes a rail deck. On the east side of the bridge, noise and visual impact will be insignificant due to the lack of sensitive receptors in industrial and vacant terrain.

Line to Northland Shopping Center: The Northland corridor is principally industrial or vacant, so neither noise nor visual impact should be significant. The one exception is the apartment complex north of the right-of-way just west of Emerson Electric, which is quite close to the alignment. It is also quite close to existing, heavily travelled N & W tracks, and to West Florissant Avenue, a major arterial, however, and noise generated by light, new,

rail vehicles on new rails should not be conspicuous in the existing noise.

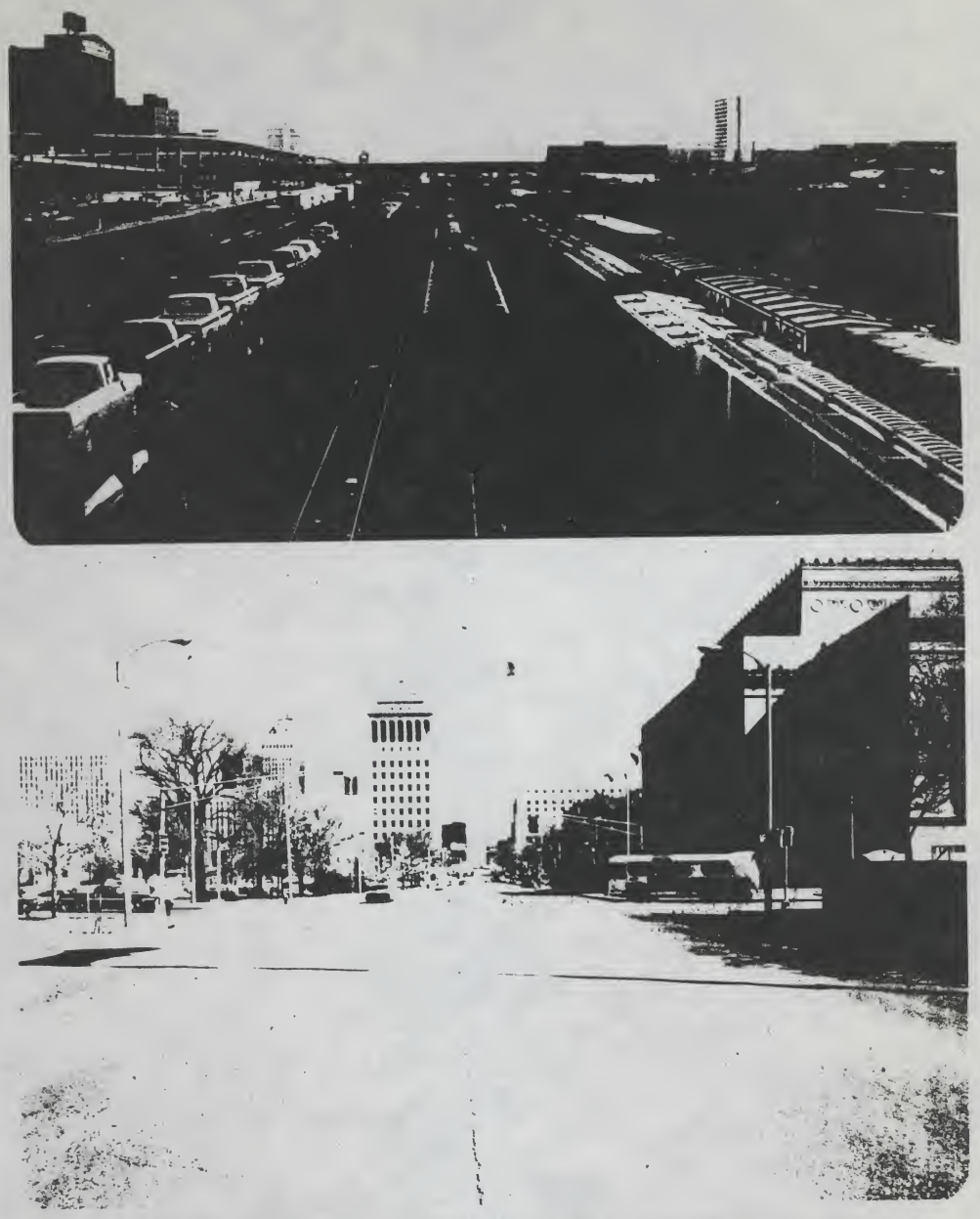
Joint Development Potential

Robert Harmon Associates selected the station locations which offered the greatest potential for joint development. To assist in this analysis, they divided the alignments into several sectors, each of which is discussed below.

RHA felt that East St. Louis had a fair amount of development potential due to such factors as land availability, multi-lane rail service, and the city's proximity to the regional core. However, the difficulties involved in realizing this potential are so great, they felt, that a light rail line and station by themselves would not provide sufficient impetus to spur measurable development. The system would serve a useful role as part of a "package deal" if investment (public and private) could be attracted concurrently with light rail construction. Until such investment is available, however, they rated East St. Louis sites as having "low priority" for joint development.

Due to the recently completed, current, and committed construction within the St. Louis CBD, along with the City's statutory redevelopment tools, RHA felt that downtown St. Louis showed strong potential for joint development, and, therefore, termed a number of sites in the CBD "high priority." These include Eads Bridge (near Laclede's Landing), 6th and Washington (near the proposed May Mall and the Cervantes Convention Center), 8th and Locust (the old post office), and the intersections of 8th Street and Walnut, Market, Chestnut, Pine, and Olive.

RHA found moderate development potential along the corridor west of the St. Louis CBD to the City line, due in part to the stabilizing influence of the medical complex around Kingshighway. The significant barrier to development supporting a light rail system on the original alignment is Highway 40, which separates potential patrons in the residential areas to the north from the light rail alignment to the south. The alternate alignment solves this problem, lying north of Highway 40 near the residential ares. One way or another, RHA felt that a station should be located somewhere in this stretch to serve hospital patrons and employees at the Kingshighway/ Euclid complex,



The original alignment (above) and the alternate alignment (below) at 18th Street. Note the barrier Highway 40 (left) presents to patrons attempting to reach the line on the original (N & W) alignment. On Market Street patrons can reach the line easily.

and rated both the Euclid and Taylor sites "medium priority."

As the alignments enter St. Louis County, RHA found a number of sites with joint development potential, as nearly all of the County sites are surrounded by at least some land parcels suitable for development, and the alignments serve a number of generators (McDonnell-Douglas, Lambert International Airport, the commercial strips in Ferguson, the University of Missouri at St. Louis) on which to anchor future development. The intersection of the alignments and Missouri Bottoms Road was rated "high priority," and several other locations in St. Louis County--Florissant Road, Airport Road, and Lindbergh Bouelvard, and Northland Shopping Center were rated "medium priority." Finally, several additional locations showed some joint development potential, including Natural Bridge, I-70, Hanley, the Innerbelt, and Brown Road.

Value Capture Techniques Applicable to St. Louis

"Joint development" involves regaining some of the money invested in transit for someone--increased property values for property owners, increased taxes for participating municipalities, increased business for businessmen around stations. "Value capture," on the other hand, involves regaining some of that investment for the transit operator or authority. A number of value capture techniques developed in other cities might be expected to work in St. Louis as well. Robert Harmon Associates supplied the following list of the techniques most applicable to the local situation.

*Long term land (or air rights) lease, possibly with a scheduled lease rate commensurate with the financial success of the project

*Benefit assessment districts

*Buy-hold

*Dedicated easements

*Packaging of station improvements above the basic station design for private sector cost sharing

Long Term Land (or Air Rights Lease: It is often necessary for a transit system to acquire space it does not actually plan to occupy, air space above its stations, for example, or ground space under elevated stations. MARTA (Atlanta) has recently completed negotiations to allow Southern Bell to build over the MARTA midtown station. BART (San Francisco) has recently recieved a number of requests for air rights over stations. The Toronto system had to acquire and raze large tracts of land to construct its largely cut-and-cover system, and is now leasing the ground over its tracks. In addition, one New York system whose track is primarily elevated, has developed a large linear park on the ground under its aerial structures. While this park does not generate income for either the transit operator or the municipality, it does make use of property that might otherwise be wasted.

Benefit Assessment Districts: Benefit assessment districts are areas assumed to recieve special economic benefit from the transit system, areas around stations, for example. In return for this benefit, the districts are assessed a special tax payable to the transit operator. In some cases this is a new tax; more often as property values rise following the installation of a transit system, property taxes automatically rise. The increment would be paid to the transit operator, rather than to the original taxing authority. BART (San Francisco) financed its Market Street

Station by selling tax allocation bonds. The bonds were paid off from tax revenues generated by new growth and increased property values in the benefit district around the station.

MARTA has not established benefit assessment districts, but has documented financial growth around a number of stations, which gives an idea of the financial growth that would be taxable under such a system. Property values around several AMRTA stations, particularly those with open land and room for growth, have doubled, and Georgia Pacific Corporation has recently announced its intention to relocate its Portland, Oregon headquarters in downtown Atlanta, citing the proximity of rapid rail transportation as a major factor in its decision.

Buy-Hold: In this situation the transit operator buys land beyond his needs and develops it as passenger-oriented facilities such as shopping center, parking garages, and snack or gift shops. The transit operator may either operate these facilities himself for income (if permitted by law) or lease them out to provide rental income. Familiar examples are the shops that line the New York and Chicago subways. This technique is especially useful at stations where extra land could be used as a park-and-ride lot pending development, as such land serves the transit operator before development as well as after.

Dedicated Easements: In some cases the owners of private buildings near the transit route can be persuaded to let the transit operator use a piece of a nearby building (dedicate an easement) for a transit station, or in some cases, to actually run the transit vehicle inside the building to unload. This saves

the transit operator the expense of acquiring land and constructing a station on the site. This has been done successfully with the Los Angeles downtown people mover at the Bunker Hill and Seventh Place stations.

Packaging of Station Improvements above the Basic Station Design for Private Sector Cost Sharing: In this case the transit operator pays for a basic station and neighboring property owners pay for whatever "frills" they wish to see added, covered connections to their stores or office buildings, for example. Woodward and Lothrup paid for an entrance into a WMATA(Washington D.C.) underground station and have been very pleased with the increase in sales due to transit riders entering the store. The Santa Fe terminal of the San Diego light rail line will eventually be developed as a transportation terminal to connect with AMTRAK and local bus service, financed in a joint effort with the city redevelopment agency, which also plans other developments in the area.

One important factor to keep in mind when designing a value capture strategy for St. Louis is that private investors will not put money into a project until the risk and opportunity for return appear balanced. This generally requires the investment of public sector "seed" money over and above the basic engineering and construction costs if the full potential of the system is to be realized.

Impact on the Bus System

If the light rail system were built, modifications of four types could be made to existing or planned bus routes:

1. Routes which overlap the light rail service area in

their entirety could be eliminated.

2. Routes which overlap a part of the light rail run or provide parallel service on nearby streets could be modified to eliminate duplication.
3. Routes which pass near a light rail station could be rerouted to allow passengers who wish to transfer to do so.
4. New shuttle service would be advisable in certain areas.

Routes that could be Deleted Entirely:

Berkeley Rapid

Jennings Rapid

King Drive/Hazelwood Express

Ramona Rapid

Tubman Express

Routes that Could be Modified to Eliminate Duplicate Service:

Airport Rapid	Airport to downtown service can be picked up on light rail with appropriate shuttle service; buses will continue to serve Northwest Plaza branch.
Alta Sita/20th & Central	Could terminate at East St. Louis Station/through passengers transfer to light rail.
Alton/St. Louis	Could terminate at East St. Louis Station/through passengers transfer to light rail.
Ashby	Some runs could be dropped on the Natural Bridge to downtown St. Louis leg.
Cahokia/Centreville	Could terminate at East St. Louis Station/through passengers transfer to light rail.
Caseyville/Collinsville	Could terminate at East St. Louis Station/through passengers transfer to light rail.

Routes that Could be Modified to Eliminate Duplicate Service: (cont.)

Cass	Some runs could be dropped on the Kingshighway to downtown St. Louis leg.
City Limits/Berkeley	McDonnell-Douglas to UMSL portion of run can use light rail; remainder will continue to be served by bus.
Collinsville/ Edwardsville	Could terminate at East St. Louis Station/through passengers transfer to light rail
Delmar Express	Some runs could be dropped on the Delmar/Kingshighway to downtown St. Louis leg.
Delmar-Forsyth	Some runs could be dropped on the Delmar/Kingshighway to downtown St. Louis leg.
Florissant Rapid	Could terminate at Florissant Station/ through passengers transfer to light rail.
Forest Park	Some runs could be dropped on the Kingshighway to downtown St. Louis leg.
Lindell Express	Some runs could be dropped on the Kingshighway/Olive to downtown St. Louis leg.
Lindenwood	Some runs could be dropped on the Grand/Market to downtown St. Louis leg.
Lucas & Hunt	Some runs could be dropped on the Northland to Delmar leg; through passengers will use light rail, buses provide local service.
McKelvey-Page Express	Could terminate at Euclid/through passengers transfer.
Natural Bridge	Could terminate at Northland Shopping Center/through passengers transfer.
Olive-Creve Coeur Express	Some runs could be dropped on the Olive/Grand to downtown St. Louis leg.

Routes that Could be Modified to Eliminate Duplicate Service: (cont.)

Olive-McKnight	Some runs could be dropped on the Olive/Grand to downtown St. Louis leg.
Paddock Hills Rapid	Could terminate at Northland Shopping Center/through passengers transfer.
Page Express	Could route into Etzel Station and terminate/through passengers transfer.
Rosemont	Could terminate at East St. Louis Station/through passengers transfer to light rail.
St. Charles Express	Could terminate at Brown Campus Station/through passengers transfer.
Washington Park	Could terminate at East St. Louis Station/through passengers transfer.
Waterloo/St. Louis	Could terminate at East St. Louis Station/through passengers transfer.

Computer projections indicate that patrons would make these transfers to achieve the time savings they offer. Obviously the transfers would have to be coordinated to avoid negating these time savings. If actual patrons are reluctant to transfer, regardless of travel time improvement, service might be cut back or eliminated gradually, to allow patrons to become accustomed to the new system.

Routes that Could be Slightly Re-routed to Serve a Station:

Brown Campus Express

City Limits/Berkeley

East St. Louis/Fairview Heights

Florissant/Berkeley

Florissant/McDonnel Orbit

Missouri Stockyards

Wellston/Maplewood

West County Express

New Shuttle Service: There are several areas where shuttle service would be advisable to collect patrons and deliver them to a light rail station. Shuttle service should be considered for Lambert Airport, Washington and St. Louis Universities, the University of Missouri at St. Louis (UMSL), University City (serving the Delmar, DeBaliviere, and Kingshighway stops), the medical complex along Kingshighway, Brown Campus, and the McDonnell-Douglas complex.

Operating Cost Savings: Bi-State could reduce its operating expenses by reducing service as discussed in the earlier sections. Based on 1980 cost figures, these service cuts could result in the basic drops in operating expenses listed below. (Because the "lost" patrons will be picked up on light rail, no revenue is lost.) In addition, because the part of the trip that is generally being taken over by the light rail system is the run into downtown St. Louis, the most congested part of the bus runs, Bi-State could realize other savings such as lower insurance costs as fewer buses need to enter the congested areas where accidents are most likely to occur. Decreased service in congested areas would also allow buses to maintain schedules more easily and to get more mileage and service out of each bus-hour.

OPERATING COST SAVINGS ASSOCIATED WITH VARIOUS SERVICE CUTS

Service Eliminated Entirely	$ 297,700
Service Modified	$2,263,500
TOTAL	$2,561,200

It would be possible for Bi-State to save approximately 3% of its annual operating costs (less costs for whatever new shuttle service had to be instituted at Bi-State's expense) by eliminating

or cutting back service (by one third, to arrive at the figures presented) on route sections that compete with light rail service. Since the light rail system is expected to cost $2.3 million to run each year, it would slightly more than pay for its own operating costs each year.

Patronage Diversions: Table 5 shows that approximately 8% to 9% of the transit patrons in 1995 will have been diverted to light rail, depending on which of the alignments is finally selected.

Effect on Bus Patrons: A major concern of the study was that bus patrons suffer no degradation of transit service due to the institution of light rail service. To determine whether service would deteriorate with the light rail system in operation, the consultant selected a number of typical trips that might be made on the light rail system and compared travel times using the bus system and light rail alignments. Operating characteristics of the bus system were taken from the current schedules. Since the light rail system is not yet in operation, assumptions about its operating characteristics were based on the operating strategy described earlier.

The results of these comparisons are illustrated in Table 6. Note that the time shown is total travel time, which includes wait time, in-vehicle time, and transfer time. For comparative bus service, the fastest, most direct bus route was selected, based on current 1980 routes and schedules.

It should also be noted that the majority of the most competitive bus routes, used for these comparisons, would probably be eliminated or modified with inauguration of light rail service.

TABLE 5

PROJECTED 1995 DAILY PATRONAGE

Mode	Original Alignment		Alternate Alignment	
	Passenger Trips	Percent	Passenger Trips	Percent
Local Bus	257,000	54	257,700	53
Express/Rapid Bus	179,500	38	181,800	38
Light Rail	39,500	8	42,800	9
TOTAL	476,000	100	482,300	100

Table 6

TRAVEL TIME COMPARISONS
(in minutes)

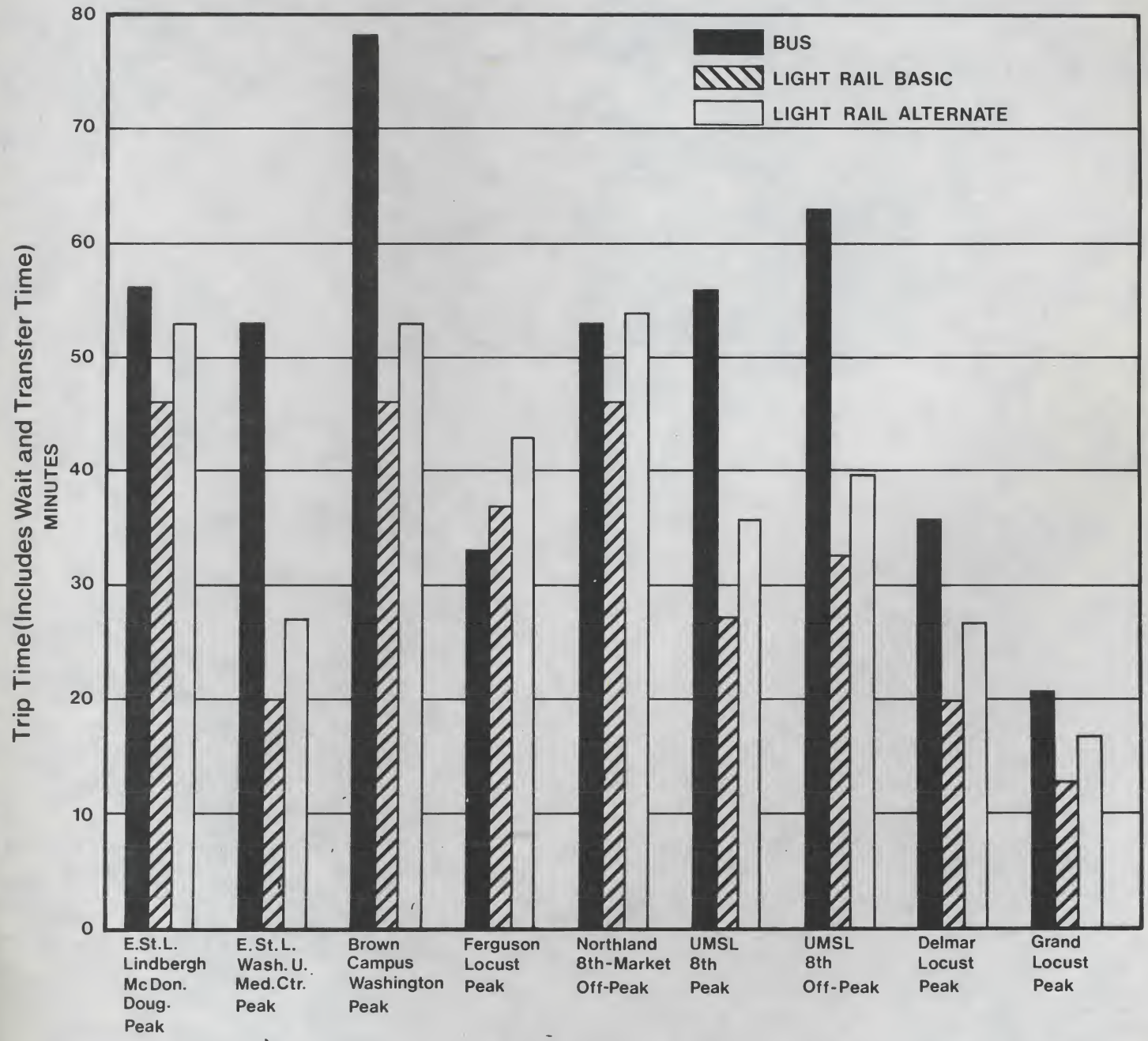
From	To	Peak Conditions			Off-Peak Conditions		
		Bus	LR Original	LR Alternate	Bus	LR Original	LR Alternate
East St. Louis	Lindbergh Blvd.	56	46	53	125***	56	63
East St. Louis	Washington U. Medical Center	53*	20	28	59*	25	32
Brown Campus	6th/Washington	78	46	53	115***	56	63
Ferguson	8th/Locust	33	37	43	73	47	53
UMSL	6th/Washington	56	27	34	63	32	39
Grand	8th/Locust	21	12	16	25	17	21
Delmar	8th/Locust	36	20	26	44	25	30
Northland	8th/Market	53	36	44	53	46	54

Notes:
*Bus Transfer required
**No service on part of run 8:00 a.m. to 3:00 p.m.

With few exceptions light rail provides faster transit service than the bus system, even using the fastest available bus service, express bus routes. One good example of this faster service is the travel time between UMSL and downtown St. Louis. During peak traffic conditions the bus service (via the Natural Bridge Express) is scheduled to take about 56 minutes to go from UMSL downtown. The light rail reduces this time by half, to about 27 minutes via the original light rail alignment and 34 minutes via the alternate alignment.

Off-peak times are generally improved even more, the trip from East St. Louis to the Washington University Medical Center, for example, dropping from 59 minutes on the bus (including a transfer in downtown St. Louis) to 25 on the original light rail alignment and 32 on the alternate alignment. In addition, the light rail system would serve mid-day trips that can not be made at all on current express bus lines such as the Brown Campus/ downtown trip, which takes 115 minutes on local buses and can not be completed at all between 8:00 a.m. and 3:00 p.m.

Figure 31
COMPARISON OF TRIP TIMES
Light Rail (2 Alignments) and Bus Selected Trips



PATRONAGE

Methodology

Estimates of 1995 patronage (ridership) were based on travel forecasting models and travel data furnished by the East-West Gateway Coordinating Council (EWGCC). This information was processed through a computer, using UMTA-approved programs, to arrive at estimates for future ridership for each alternative.

Projected 1995 Daily Patronage

Table 7 presents the projected 1995 daily patronage by mode. Note that the proposed Light Rail System is expected to accommodate between 8 and 9 percent of the transit travel in 1995. This amounts to 39,500 daily passenger trips on the original light rail alignment and 42,800 on the alternate alignment.

The total 1995 transit patronage projections of around 480,000 passenger/trips, is almost twice Bi-State's current daily patronage of around 250,000 to 280,000 passenger trips.

Projected 1995 Daily Passenger Loadings

Estimates of 1995 daily passenger loadings (number of passengers riding the system at any given point) are illustrated in Figures 32 and 33. Significant observations follow:

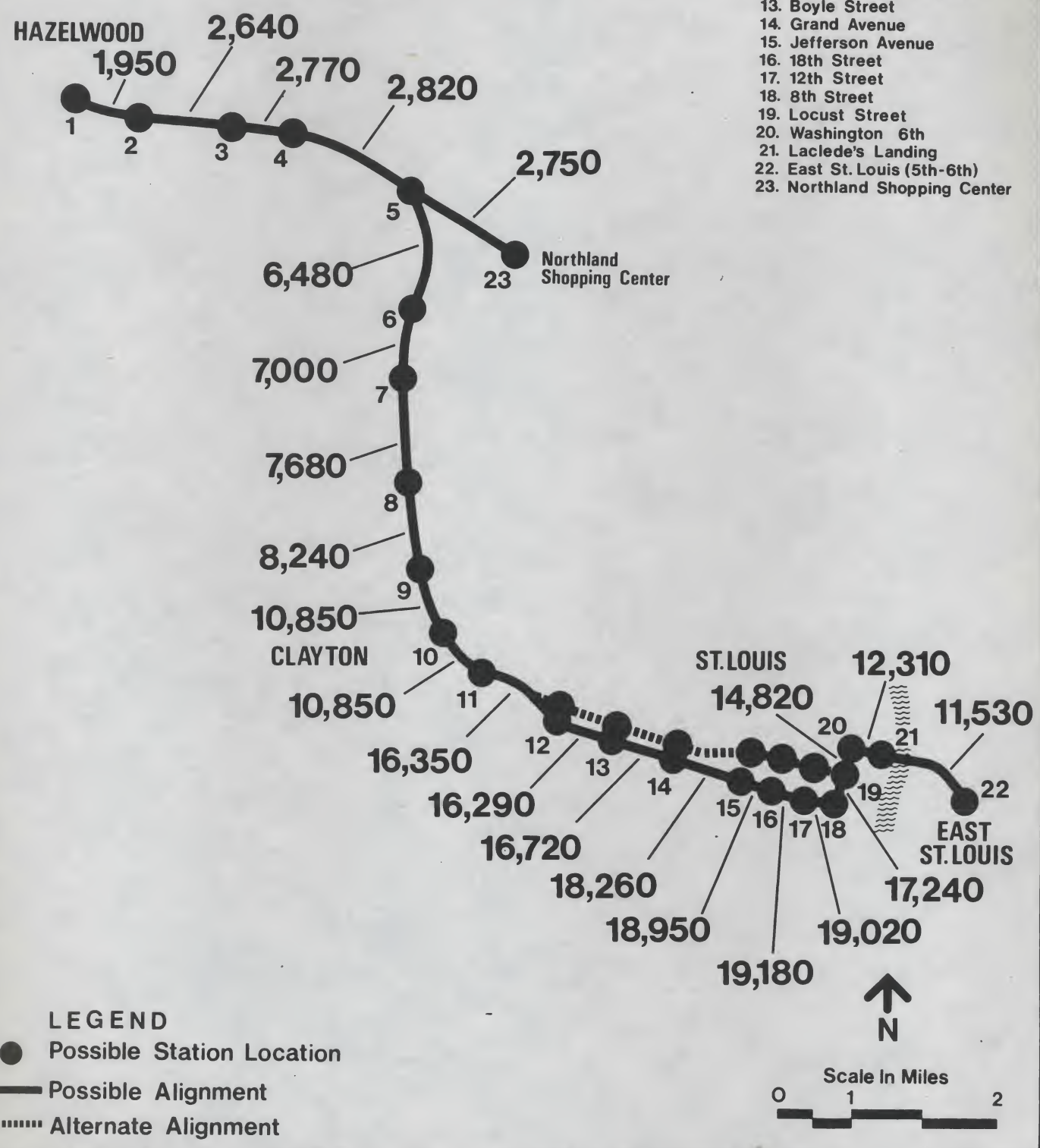
1. The lower operating speed (the result of surface operation along Forest Park and Market) on the alternate alignment results in somewhat lower passenger loadings in areas outside the City of St. Louis.
2. In addition to serving development adjacent to the stations, the Light Rail System also serves large volumes of bus passengers for a portion of their trips.

TABLE 7

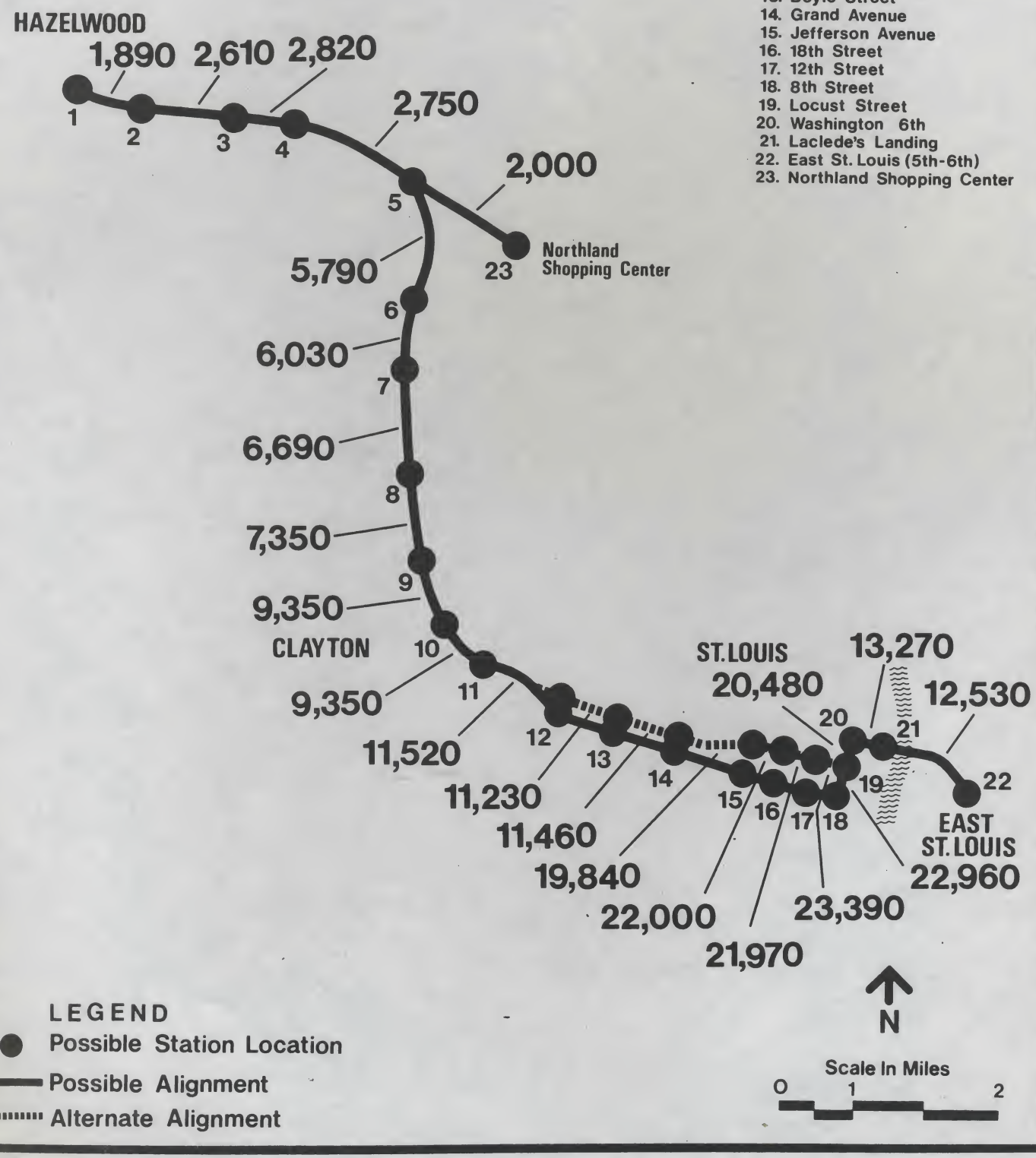
PROJECTED 1995 DAILY PATRONAGE

Mode	Original Alignment		Alternate Alignment	
	Passenger Trips	Percent	Passenger Trips	Percent
Local Bus	257,000	54	257,700	53
Express/Rapid Bus	179,500	38	181,800	38
Light Rail	39,500	8	42,800	9
TOTAL	476,000	100	482,300	100

Daily Passenger Loadings-1995
Original Alignment
Proposed St.Louis
LIGHT RAIL SYSTEM
Figure 32



Daily Passenger Loadings-1995
Alternate Alignment
Proposed St.Louis
LIGHT RAIL SYSTEM
Figure 33



STATION LOCATIONS

1. Brown Campus
2. Lindbergh Boulevard
3. Brown Road
4. Hanley Road
5. Florissant Road
6. I-70
7. Natural Bridge Road
8. St. Charles Rock Road
9. Etzel Street
10. Delmar Boulevard
11. De Baliviere Avenue
12. Kingshighway Boulevard
13. Boyle Street
14. Grand Avenue
15. Jefferson Avenue
16. 18th Street
17. 12th Street
18. 8th Street
19. Locust Street
20. Washington 6th
21. Laclede's Landing
22. East St. Louis (5th-6th)
23. Northland Shopping Center

Heavy transfer passenger volumes (between bus and light rail) were observed at the East St. Louis station and at the Grand Boulevard station.

Weekend and Holiday Patronage

Using historical data, estimates were also made of weekend and holiday patronage. These estimates are shown below for both the original (N & W) and alternate (Market Street) alignments.

	Original Alignment	Alternate Alignment
Weekday	39,500	42,800
Saturday	18,000	19,500
Sunday/Holiday	6,400	7,000

Annual Patronage

Based on these figures, annual patronage for 1995 is estimated as follows:

Original (N & W) Alignment: 11.4 million passenger trips

Alternate (Market) Alignment: 12.3 million passenger trips

SYSTEM CAPITAL COSTS

Introduction

The estimated costs presented in this chapter are preliminary, based on an inspection of the proposed rights-of-way, discussions with railroad officials (N & W and TRRA) and the consultant's proposed engineering solutions to specific alignment problems. Every attempt was made to develop realistic and accurate cost estimates. Nevertheless, the estimates can be affected by two factors:

*Inflation: Construction costs have been increasing rapidly in the past few years, around 10 percent annually. Should this continue, the construction costs could be expected to increase by 61 percent by 1985 and by 159 percent by 1990.

*System Design: The system is currently envisioned as a functional, safe, and efficient system, but designed without frills such as elaborate stations or automatic train controls, etc. Subsequent design changes could materially increase the costs of the system unnecessarily.

Unit Construction Cost Estimates

In order to estimate the cost of constructing the light rail system, unit construction cost estimates were developed using recent construction bids for similar rail transit projects and previous research reports such as the Rail Transit System Cost Study, developed by Thomas K. Dyer, Inc. Listed below are the construction cost items, along with a discussion of what each item includes and the resulting unit costs for the year 1980.

Route construction costs provide for the necessary grading, drainage, retaining walls, utilities, and structures required for preparation of the right-of-way (subgrade) for construction of the tracks. For the purposes of this study, separate unit costs were developed for at-grade, at-grade retained, aerial, and subway sections. The unit cost estimates do not include costs for redoing existing highway structures nor the costs of any N & W or TRRA pole or track relocation work. All unit cost estimates shown below are for double tracks:

Route construction & trackwork costs include the costs of preparing the ground to support tracks, and then laying the track on that base. (San Diego light rail system)

At-grade	$ 960,000/mile
At-grade (retained)	$6,600,000/mile
Aerial (elevated)	$8,800,000/mile
Subway	$58,000,000/mile

Trackwork costs include all costs associated with placing the track in its final position, including ballast, ties, and rail, but not the cost of electrification. Again, unit cost estimates, shown below, are in 1980 dollars and cover double track sections.

At-grade	$1,060,000/mile
Aerial/Subway	$1,230,000/mile

Electrification costs include all costs associated with providing traction power and include the electrical distribution system (overhead catenary, poles, and hardware) and substations. Estimated 1980 unit costs are shown below.

Substations	$850,000 each
Catenary, poles, hardware	$80,000/mile

Train Control costs are costs of electrically operated track-side equipment, control switches (interlocks), and signaling to protect highway grade crossings. These are shown below in 1980 dollars.

Wayside supervisory controls	$675,000/mile
Grade crossing protection	$225,000 each
Interlocking	$ 30,000 each

Right-of-way costs include the acquisition costs of necessary rights-of-way, excluding land costs for the yards and shops. Right-of-way costs were estimated at $174,000 per mile of double track, which is basically equivalent to $60,000 per acre, the approximate cost of good industrial land. Industrial land values were used since much of the rail rights-of-way are adjacent to industrial properties. It must be noted, however, that right-of-way costs are the most difficult to estimate. Discussions with railroad officials were not helpful in arriving at more accurate right-of-way costs. In fact, rather than purchasing the necessary right-of-way

it may prove more economical to negotiate long term leases with the affected railroad companies.

In addition, the estimated right-of-way costs exclude any acquisition costs for the TRRA tunnel and the Eads Bridge.

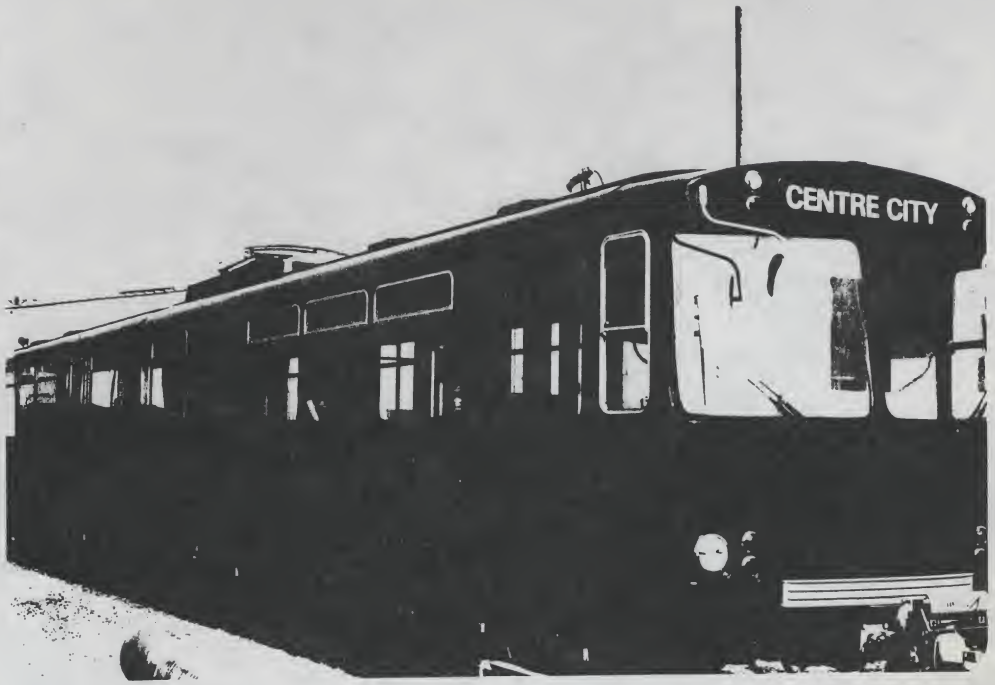
Station costs include costs of entire, completed, station complexes, including platforms, seats, stairs, ramps, elevators, and escalators where applicable. Typical stations are assumed to be functional but not elaborate. Costs of station access and parking areas are n t included in the unit cost (1980) estimates shown below:

At-grade	$50,000 each
Aerial	$660,000 each
Subway	$1,280,000 each

Vehicle costs include the cost of purchasing new light rail vehicles; estimated in 1980 dollars, costs are shown below.

Vehicles

$770,000 each



Light rail vehicle recently purchased for the San Diego light rail system from a German manufacturer

Miscellaneous costs include costs of reconstructing/modifying existing highway structures, construction of station access and parking (park/ride) areas, and railroad reloaction work based on the following unit cost estimates.

Structure	$530,000 each
Parking	$2,500/space
Access	$500,000/station
Track Relocation	$100/linear foot (single track)

Estimated 1980 Construction Costs

Table 8 and Table 9 present the total estimated construction costs (1980) by item for both the original (N & W) alignment and the alternate (Market Street) alignment. The two alignments are identical except for the section between Kingshighway and Eighth Street in downtown St. Louis, The original alignment in this section follows along the existing railroad tracks into the Eighth Street tunnel, whereas the alternate alignment follows Forest Park Parkway and Market Street. The construction cost estimates do not differ significantly. The cost of the original (N & W) alignment amounts to $290.58 million, as compared to $294.05 million for the alternate alignment. Principal cost differences occur in the following two areas: a longer, more expensive tunnel at Kingshighway is required for the alternate alignment, which tends to offset any savings of at-grade construction along Forest Park Parkway and Market Street. Second, the right-of-way cost is $720,000 lower on the alternate alignment, due to the use of existing, City-owned street rights-of-way.

Table 8

ESTIMATED CAPITAL COSTS

St. Louis Light Rail System
Original Alignment
Approximately 22 Miles

Item	Estimated 1980 Capital Costs ($ millions)
Construction Costs	
Route Construction	$ 99.49
Trackwork	24.23
Electrification	14.97
Train Control	16.19
Stations	9.12
Yards/Shops	9.00
Highway Structures	6.89
Access	11.50
Park/Ride	6.75
Subtotal	$198.14
Right-of-Way[1]	3.60
Vehicles	15.40
Engineering & Design (8%)	15.85
Construction Management (5%)	9.91
Contingency & Support (20%)	39.63
Eads Bridge Restoration[2]	9.05
Subtotal	$ 93.44
TOTAL	$291.58

[1]Does not include acquisition cost of Eads Bridge or TRRA tunnel.
[2]Eads Bridge over the Mississippi River, Bridge Inspection and Engineering Report, Howard, Needles, Tammen, & Bergendoff, (full restoration) 1980.

Table 9

ESTIMATED CAPITAL COSTS

St. Louis Light Rail System
Alternate Alignment
Approximately 22 Miles

Item	Estimated 1980 Capital Costs ($ millions)
Construction Costs	
Route Construction	$103.87
Trackwork	23.76
Electrification	14.82
Train Control	16.04
Stations	7.89
Yards/Shops	9.00
Highway Structures	6.89
Access	11.50
Park/Ride	6.75
Subtotal	$200.52
Right-of-Way[1]	$ 2.91
Vehicles	15.40
Engineering & Design (8%)	16.04
Construction Management (5%)	10.03
Contingency & Support (20%)	40.10
Eads Bridge Restoration[2]	9.05
Subtotal	$ 93.53
	$294.05

[1]Does not include acquisition cost of Eads Bridge or TRRA tunnel.
[2]Eads Bridge over the Mississippi River, Bridge Inspection and Engineering Report, Howard, Needles, Tammen, & Bergendoff (full restoration) 1980.

OPERATING COSTS & REVENUES

Estimated Annual Vehicle Mileage

Based on the operating plan described earlier, vehicle mileage was calculated as follows:

Route A:	East St. Louis--Brown Campus	
	Weekday Vehicle Mileage	530,600
	Weekend & Holiday Mileage	80,400
	TOTAL	611,000
Route B:	East St. Louis--Northland Shopping Center	
	Weekday Vehicle Mileage	476,500
	Weekend & Holiday Mileage	72,200
	TOTAL	548,700
Total:	Routes A & B	
	Weekday Vehicle Mileage	1,007,100
	Weekend & Holiday Mileage	152,600
	TOTAL	1,158,700

Estimated Annual Operating Costs (1980)

Using operating cost formulas developed by DMJM, it is estimated that providing the type and level of service specified above would cost about $2.4 million annually, in 1980 dollars. This breaks down as follows:

Route A:	East St. Louis--Brown Campus	$1.25 million
Route B:	East St. Louis--Northland Shopping Center	$1.14 million
	TOTAL	$2.39 million

Projected 1985 - 1995 Annual Operating Costs

Based upon an annual inflation rate of 10 percent, projected future system operating cost estimates are as follows:

	Annual Operating Costs ($ millions)	
	1985	1995
Route A	$2.01	$5.23
Route B	1.84	4.77
TOTAL	$3.85	$10.00

Estimated 1995 Farebox Revenues

Estimates of revenue (farebox) derived from the operation of the light rail system are based upon assumptions relating to future fares. Since fare increases are subject to political and public pressures, as well as increases in transit operating costs, it is extremely difficult to estimate with any certainty future transit farebox revenues. However, there are several considerations which should be discussed.

In general over the long run, it is reasonable to project that fare increases will keep pace with inflation and/or transit operating cost rates. This certainly has not been the case during the past five to ten years; however, this trend of declining farebox revenues cannot be expected to continue. Therefore it is logical to argue that operating (farebox) revenues will grow at the inflation rate. Since we have already used an inflation rate of 10 percent annually for costs, it follows that fares could also be increased by the same rate, which results in the following fares:

COST-BENEFIT ASSESSMENT

This chapter presents an assessment of the costs and benefits derived from the construction of the proposed 22-mile light rail system. The assessment was conducted by looking at the light rail system and its impact in various areas in terms of the light rail goals and subgoals established earlier. Keep in mind that these goals and subgoals may be revised to more accurately state the current thinking of the region and what the region hopes to accomplish with a light rail transit system, see Table 10.

Goal A: Improve Transportation

Improve Access to the St. Louis CBD: Without question the proposed light rail system improves access to the St. Louis CBD. The technical report, "Impact of Light Rail on the Existing Bus System" clearly shows that the light rail system is superior to a conventional surface bus system. For example, from the UMSL area to the St. Louis CBD, the light rail system reduces travel time over 50 percent when compared to existing Bi-State bus service. This is typical of most areas served by the light rail system. Thus, the St. Louis CBD is more accessible to people living or working along the proposed alignment with the construction of the light rail system.

Improve Access to Activity Centers: Again, without question the light rail system significantly improves the accessibility to activity centers served by the system. In addition to the St. Louis CBD, the accessibility of the following activity centers would be significantly enhanced:

*East St. Louis CBD and new public developments around the proposed East St. Louis station

*Laclede's Landing and the Gateway Arch, including the riverfront area

*Union Station and its surroundings

*St. Louis University and surrounding areas

*Washington University Medical Center and surrounding redevelopment areas

*Forest Park

*UMSL

*Northland Shopping Center

*Ferguson

*McDonnell-Douglas

*Lambert International Airport

*Brown Campus

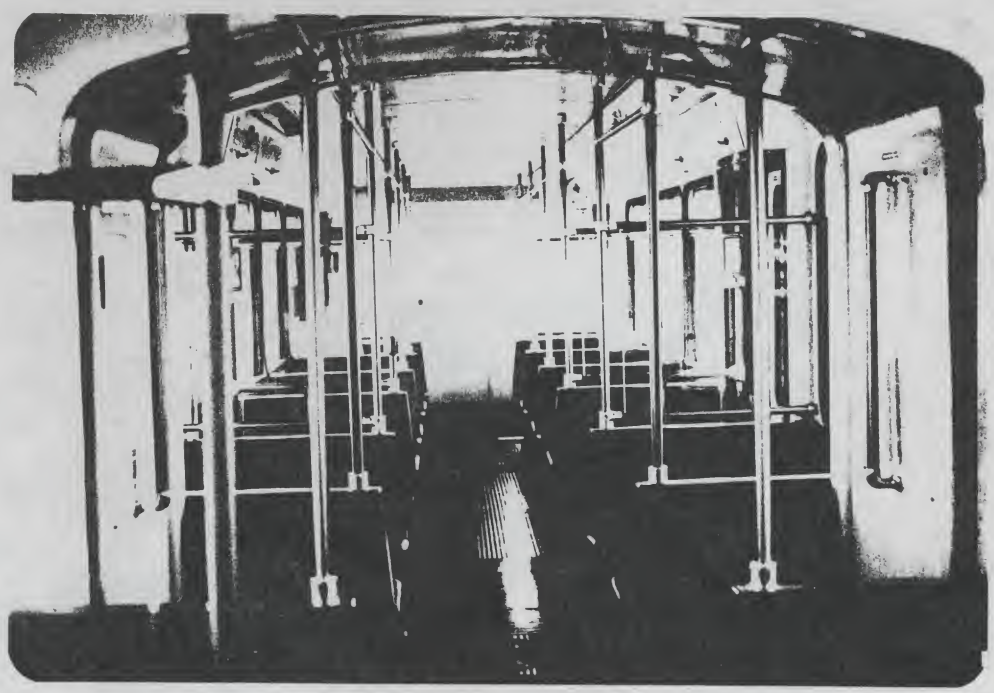
The light rail system greatly improves accessibility between East St. Louis and activity centers in Missouri, such as the Washington University Medical Complex. This is because of the faster service provided by light rail and also because, at present, a person travelling between these points must transfer from an Illinois bus to a Missouri one, which wastes time. In fact, over 1,500 Illinois riders are projected to use the light rail system to reach destinations beyond the St. Louis CBD daily.

Reduce Vehicular Traffic Congestion: The proposed light rail system could not be expected to reduce traffic congestion to any measurable degree. While some motorists will certainly abandon their cars for this newer, faster, and more acceptable form of mass transportation, the overall effect on traffic congestion will be minimal. Future travel forecasts suggest a shift of less than

five percent from automobile to transit. Higher diversion from automobile to mass transit could be expected if the region imposed severe penalties on auto travel and parking in the downtown areas.

Improve Transit Efficiency: In terms of patronage per vehicle-mile or vehicle-hour, light rail is clearly superior to a surface bus system. It is estimated that the proposed light rail system will carry between 9.8 and 10.6 passengers per vehicle-mile. The Bi-State system currently carries about two to three passengers per vehicle-mile. Of course some bus routes are more productive, while others do not carry even one passenger per vehicle-mile. Regardless, the light rail system, because of its superior service and higher capacity, is significantly more efficient than an all-bus system.

Improve Cost-Effectiveness of Transit: The rapidly escalating operating costs of surface bus transit systems tend to make rail transit more cost-effective. For example, see Bi-State's recent operating cost statistics in the table on the next page. This represents average annual increases of 12.8 percent in cost/passenger and 11.0 percent in cost/vehicle-mile. Thus, the cost of providing



The ability of light rail to carry more passengers/ trip than buses, decreases fuel and labor costs.

Bi-State Operating Costs	Cost/Passenger	Cost/Vehicle-Mile
1974	$0.51	$1.25
1975	$0.52	$1.40
1976	$0.62	$1.54
1977	$0.70	$1.77
1978	$0.82	$1.99
1979	$0.91	$2.19

surface bus transit has been increasing at a rate of around ten percent annually. One way to help reduce this cost is to convert to electric rail transit to reduce tobh labor and energy costs, two significant factors in transit operating costs. Shown below are comparable cost-effectiveness figures for the proposed light rail system.

Light Rail Operating Costs	Cost/Passenger	Cost/Vehicle-Mile
1985	$0.49/$0.45	$3.32
1995	$0.88/$0.81	$8.62

Note that even with projected increases in light rail operating costs, up to $8.62 per vehicle-mile in 1995, the cost per passenger is estimated at only $0.81 for the alternate alignment and $0.88 for the original light rail alignment. This is slightly lower than the 1979 Bi-State system average of $0.91 per passenger.

Without question the light rail system is more cost-effective to operate than a surface bus system when one considers only operating, not capital costs. Adding the annualized capital costs of light rail increases the estimated annualized costs as shown in Table 11.

Encourage Greater Use of Existing Transportation Resources: One of the greatest existing transportation resources involves the rights-of-way dedicated to transportation--highway, rail, and other transportation modes. Buses make use of streets and highways; the proposed light rail system for St. Louis was initially conceived to make maximum use of existing railroad rights-of-way. The goal was putting these underutilized lands to greater use, while at the same time taking advantage of of an existing travel corridor,

Table 11

ANNUALIZED COST SUMMARY
(Original Light Rail Alignment)

	Annual Operating Costs ($ millions)	Operating Cost/ Passenger	Annualized Capital Costs ($ millions)	Capital Cost/ Passenger	Total Cost ($ millions)	Total Cost/ Passenger
1980	2.39	$0.39	23.67	$3.88	26.06	$4.27
1985	3.85	$0.49	23.67	$3.00	27.52	$3.49
1995	10.00	$0.88	23.67	$2.08	33.67	$2.96

one which is already clearly defined.

Without question, the light rail system does encourage greater use of existing transportation resources, in this case underutilized railroad rights-of-way and railroad improvements such as the abandoned TRRA tunnel and Eads Bridge railroad deck.

Minimize Capital Costs: Current public concern over inflation and increased government spending must certainly be considered, especially when a community embarks on a capital-intensive program such as light rail transit. The construction costs of any rail transit system can be expensive, and costs are increasing rapidly.

To minimize capital costs for transit in St. Louis, the community would definitely stick with an all-bus system and merely expand it as warranted. The total estimated cost for a regional system for St. Louis could easily exceed $1 billion. The corridor currently under study will probably cost between $291 and $294 million in 1980 (current) dollars, and could be expected to run up to $750 million in 1990 dollars, assuming a ten percent annual inflation rate.

Improve Transit Service to Elderly/Handicapped: There is no reason to anticipate that a light rail system, by itself, will bring about any improvement in transit service to the elderly and handicapped. While the light rail system would be designed to ensure full accessibility, overall throughout the region it is unlikely that there would be any improvement in service. Probably the end result would be some cutback in bus service, with an overall shift toward light rail service, especially in the light rail corridor.

Improve Transit Service to Transit Dependents: The proposed light rail alignment parallels, to a great degree, large concentrations of transit dependent people (basically people without access to an automobile), as shown in Figure 5 of the technical report, "Location/Design of Stations, Auto-Intercept Facilities, & Route Termini." Moreover the light rail system provides direct service to major employment centers (St. Louis CBD and McDonnell-Douglas), to the Washington University Medical Complex, and to numerous educational institutions, apartments, and medical facilities. Thus, the proposed light rail system does provide for improved service to transit dependents living along the corridor.

Goal B: Promote Economic Development*

Stimulate and Direct New Development: Implementation of a LRT system would stimulate a great deal of new development and concentrate it around the light rail corridor, reducing urban sprawl. For example:

> Employment: Implementation of a LRT system would add a net of 5,000 (Market Street Alignment) to 5,400 (N & W Alignment) to the corridor's labor base. This increment represents a 4% increase over the baseline projection for 1995. Assuming a constant growth rate from 1970 to 1995, the LRT-induced employment growth represents an increase of almost 30% in the net growth expected between 1980 and 1995.
>
> Business Property: The net incremental investment

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*All figures in this section supplied by Robert Harmon Associates

in new space will approximate $20 to $24 million (400,000 square feet).

Dwelling Units: It is estimated that approximately 1,900 additional dwelling units will be constructed in the St. Louis County segment of the alignment if the LRT system is implemented. Over 50% of this would probably be situated in the vicinity of the LRT terminus at Brown Campus; the rest would be distributed among the other station areas in the County. The number of incremental dwelling units in the City segment of the corridor would be 800 for the N & W alignment or 1,400 under the Market Street option. Table 12 summarizes anticipated new development in the corridor.

Retail Sales: The LRT system would draw an additional 5,000 - 5,400 employees into the corridor; based on national average spending figures, these employees would spend about $2.5 million in the corridor and its immediate surroundings. This is equivalent to about 1% of the total current CBD retail sales.

Public Revenue Gains: The net public revenue gains attributable to the City and County can be summarized as follows:

<u>City of St. Louis</u>

Net Incremental Sales Tax Revenues = $12,000/year

Net Incremental Property Tax Revenues = $500,000/year

Table 12
STATION AREA DEVELOPMENT PROFILES

Station	Commercial			Residential		
	Employment Type	Timing	Size	Residence Type	Timing	Size
East St. Louis	--	--	--	--	--	--
Laclede's Landing	Office	Short-term	50,000 sq.ft.	Rehab/ Warehouse	Short-term	100 units
Washington/6th/7th	Office	Short-term	200,000 sq.ft.	--	--	--
Locust	Office	Short-term	150,000 sq.ft.	--	--	--
Walnut	--	--	--	--	--	--
8th/Market	--	--	--	--	--	--
12th/Market	--	--	--	--	--	--
12th/N & W	Industrial/ Office	Long-term	75,000 sq.ft.	--	--	--
18th/Market	--	--	--	--	--	--
18th/N & W	Retail/ Office	Long-term	100,000 sq.ft.	--	--	--
Jefferson/Market	Office	Long-term	25,000 sq.ft.	--	--	--
Jefferson/N & W	--	--	--	--	--	--
Grand/Market	--	--	--	Hi-rise	Long-term	150 units
Grand/N & W	--	--	--	--	--	--
Boyle/Market	Retail	Long-term	20,000 sq.ft.	Townhouse/ Mid-rise	Short-term	200 units
Boyle/N & W	--	--	--	--	--	--
Kingshighway/Market	Office	Short-term	60,000 sq.ft.	Hi-rise	Short-term	350 units
Kingshighway/N & W	Office	Short-term	35,000 sq.ft.	Mid-rise	Short-term	100 units
DeBaliviere	--	--	--	Mid-rise	Short-term	400 units
Delmar	Retail/ Office	Long-term	80,000 sq.ft.	Mid-rise	Long-term	200 units
Etzel	--	--	--	--	--	--
St. Charles Rock Rd.	Retail	Long-term	85,000 sq.ft.	--	--	--
Natural Bridge	Office	Long-term	30,000 sq.ft.	Townhouse	Long-term	150 units

Table 12(cont.)
STATION AREA DEVELOPMENT PROFILES

	Commercial			Residential		
Station	Employment Type	Timing	Size	Residence Type	Timing	Size
I-70	Office	Long-term	40,000 sq.ft.	Mid-rise	Long-term	200 units
Florissant	Retail	Long-term	20,000 sq.ft.	Townhouse	Long-term	125 units
Hanley	Industrial/ Office	Short-term	75,000 sq.ft.	Mid-rise	Long-term	200 units
Brown	Industrial/ Office	Long-term	40,000 sq.ft.	--	--	--
Lindbergh	Industrial/ Office	Short-term	75,000 sq.ft.	--	--	--
Brown Campus	Industrial/ Office	Short-term	200,000 sq.ft.	Townhouse/ Mid-rise	Short-term	1,000 units
Northland Shopping Ctr.	Commercial	Long-term	50,000 sq.ft.	Mid-rise	Long-term	200 units

Source: Robert J. Harmon Associates, Inc.

Net Incremental Earnings Tax Revenues = $40,500/year

Net Merchants' Ad Valorem Tax Revenues = $79,000/year

Total City Incremental Earnings = $630,000/year

St. Louis County

Net Incremental Property Tax Revenues = $480,000/year

Net Merchants' Ad Valorem Tax Revenues = $75,000/year

Total County Incremental Earnings = $555,000/year

Construction Employment Gains: The construction of induced development projects will create a net of about 700 - 800 person years of regional construction employment plus 2,100 person years in the construction of the light rail system itself.

Complement Existing and Planned Development: The LRT system will, again, concentrate development in areas already urbanized, making them more attractive, and outlying, currently undeveloped areas, less so.

Population: The East-West Gateway baseline population projections (without LRT) for the corridor call for a loss of 1,825 residents between 1970 and 1995 (a drop of 2% from 108,315 to 106,480). Either of the two alignments would generate sufficient increases in corridor residential development to reverse this loss and produce a net gain of between 2.7% (N & W) and 4.9% (Market Street).

Renovation: It is likely that at least 100,000 square feet of existing space at various stations will undergo extensive renovation/rehabilitation in

response to the market stimulus provided by the LRT. At an average cost of $25.00 per square foot, this represents an additional investment of $2.5 million.

Retail Growth: The most likely impact will be the reinforcement of existing neighborhood-oriented establishments at or near station areas and creation of a new cluster of neighborhood retail stores at the Brown Campus station. The net gain in corridor retail sales from induced population increases will range from $3 to $4 million.

Increased Property Values: Office developers and owners will receive a net annual benefit of $1 million over and above normal office rental fees as a result of premium rentals which can be obtained because of proximity to the LRT.

Reinforce Downtown St. Louis as the Point of Regional Focus:

The system improves access to downtown St. Louis, which gives downtown businesses, especially office developments, a competitive edge over locations not so served. This edge could help downtown recover a greater share of the region's market for office space.

Promote more Efficient and Rational Land Use: The proposed alignment utilizes currently vacant railroad rights-of-way, and concentrates new development along the alignment, retarding urban sprawl and the need for expanding water, sewer, road, and other public services to areas not currently served. In addition it spurs development around station areas, providing economic incentives

for utilizing vacant or underutilized land in these areas.

Goal C: Improve the Quality of the Environment

Improve Air Quality: In order to improve the quality of the air, it would be necessary to greatly reduce auto travel in the region, either by converting motorists to transit or by reducing total travel. While the light rail system will help to encourage people to use transit, the numbers of motorists which would be diverted to the light rail system would be small. At best, we could not expect more than a few percent of auto travelers to shift to transit, a shift too small to have any measurable effect on air quality.

Minimize Noise Impact: Transportation noise can be reduced by reducing travel volumes and by applying noise suppressors to vehicles. Overall, the proposed light rail system will have little impact on noise. Since the light rail system is not expected to have any significant impact on auto travel, it would not reduce noise from automobile travel to any significant degree. Light rail transit operating in an area which is already affected by railroad noise should not, on the other hand, materially increase noise levels. First, the noise from light rail operations would be significantly lower than noise generated by freight trains, both in terms of duration and in terms of volume. Therefore, the proposed light rail system is not expected to increase noise levels

along the proposed alignment. There are, however, several areas where special attention must be directed in the design phase to mitigate noise impact on surrounding properties.

Minimize Impact on Historical Sites: In general the light rail system will be a positive force by helping to encourage reuse of sites with historical or architectural significance. Four such sites can be found along the proposed light rail alignment: the Delmar Station, Union Station, the Old Post Office, and the Eads Bridge. The light rail system will tend to generate some additional movement of people through these sites, since each location is currently identified as a light rail station location. Other than these positive impacts, the light rail system should have little impact on any historic site in the St. Louis area.

Mimimize Community (Neighborhood) Disruption: The proposed light rail system, because it follows an existing transportation corridor, does little that would disrupt communities or neighborhoods. It does not create any new barriers to travel, nor does it bisect existing neighborhoods or interfere with local pedestrian circulation patterns. As discussed in the technical report, "Aesthetic, Environmental," and Historical Impact Analysis," the addition of a light rail system along the railroad tracks does create a few aesthetic and noise problems for adjoining neighborhoods. These problems can, for the most part, be mitigated through proper design and landscaping, particularly the introduction

of berms, etc. to shield and protect sensitive areas.

Improve Aesthetic Quality: The introduction of a light rail system into an existing railroad corridor can, in general, be a positive impetus to clean up and improve the aesthetic quality of the railroad right-of-way. Certainly additional tracks at grade alongside the existing railroad tracks do little to change the aesthetic quality of the area. However, where the light rail tracks are elevated above the railroad tracks, the aesthetic quality of the railroad corridor is materially changed, generally for the worse. This is especially true where the light rail tracks are elevated in an area that is primarily residential, open space, or parkland. In these areas the elevated light rail tracks do tend to destroy pleasing views, and, generally, downgrade the aesthetic quality of neighboring areas. Fortunately these areas are limited and apply mainly to the alternate alignment.

Minimize Construction Impact: Constructing any new transportation system within an urbanized area such as St. Louis is difficult. Construction can disrupt normal traffic and pedestrian flows, create hazardous traffic conditions, require major traffic detours, and, in general, place an added burden on already overcrowded streets. In addition, construction can impede access to commercial establishments, thereby reducing sales and profits. Construction can also produce additional noise, smoke, and other environmental problems uless carefully monitored and controlled.

Although no construction project of this size can be entirely free of adverse construction impact, the proposed light rail system, located as it is in an existing railroad corridor, should not be as disruptive as constucting a similar system through residential neighborhoods or commercial development. Nevertheless, there will be significant adverse impact during construction.

Goal D: Conserve Energy

Reduce Automobile Energy Consumption: The light rail system will have little impact on automobile energy consumption. As noted before, less than five percent of the total automobile traffic is likely to consider shifting to light rail. While this will certainly tend to reduce energy consumption, the net result will probably be insignificant.

Improve Energy Efficiency of Transit Vehicles: Research relating to the energy efficiency of transit vehicles suggests that with capacity loading, a rail transit system can produce an energy savings of around 25 percent, in terms of energy consumed per passenger. This savings does not recognize the energy consumed for station operation and maintenance activities. Even with allowances for these items, a light rail system is clearly more energy-efficient than either a diesel bus or an automobile.

Assessment of Achievement of Goals & Subgoals

Using the selected light rail goals and subgoals and the weightings developed by the Technical Advisory Committee, the

consultant applied a numerical system to arrive at a comparative assessment of the proposed light rail transit system, see Table 13. For each subgoal, the consultant rated the light rail system according to the following arbitrary scale: +8, +6, +3, 0, -3, -6, -8. A +8 indicates an extremely high level of compliance with a specific subgoal, etc. For the purposes of this assessment, the scoring used the all-bus system as a baseline.

In summary, the assessment shows that either light rail system provides improved transportation service, promotes economic development, but does little to improve the quality of the environment or to conserve energy.

This numerical rating system is somewhat arbitrary and should be considered merely as an attempt to develop an overall assessment of the light rail system's potential for fulfilling community goals.

It is suggested that the Technical Advisory Committee review this assessment and the previously selected goals and subgoals. Perhaps each member of the Technical Advisory Committee should rate the light rail systems' performance individually. These individual ratings can then be combined to represent a Technical Advisory Committee consensus.

Table 13

GOAL & SUBGOAL ACHIEVEMENT ASSESSMENT

Goals	Committee Weighting	All-Bus/Baseline	Unweighted		Weighted	
			Original LRT	Alternate LRT	Original LRT	Alternate LRT
IMPROVE TRANSPORTATION						
1. Improve Access to St. Louis CBD	.68	0	+6	+6	+4	+4
2. Improve Access to Activity Centers	.72	0	+6	+6	+4	+4
3. Reduce Vehicular Traffic Congestion	.60	0	0	0	0	0
4. Improve Transit Efficiency	.60	0	+3	+3	+2	+2
5. Improve Cost-Effectiveness of Transit	.47	0	+3	+3	+1	+1
6. Encourage Greater Use of Existing Transportation Resources	.51	0	+3	+3	+2	+2
7. Minimize Capital Costs	.44	0	-6	-6	-4	-4
8. Improve Transit Service to Elderly/ Handicapped	.48	0	0	0	0	0
9. Improve Transit Service to Transit Dependents	.55	0	+3	+3	+2	+2
					+11	+11
PROMOTE ECONOMIC DEVELOPMENT						
1. Reinforce downtown St. Louis as the Point of Regional Focus	.55	0	+6	+6	+3	+3
2. Stimulate & Direct New Development	.54	0	+3	+3	+2	+2
3. Complement Existing & Planned Development	.61	0	+3	+3	+2	+2
4. Promote more Efficient & Rational Use of Land	.50	0	0	0	0	0
					+7	+7
IMPROVE THE QUALITY OF THE ENVIRONMENT						
1. Improve Air Quality	.35	0	0	0	0	0
2. Minimize Noise Impact	.23	0	0	0	0	0
3. Minimize Impact on Historical Sites	.26	0	+3	+3	+1	+1
4. Minimize Community (Neighborhood) Disruption	.41	0	0	0	0	0

Summary of Costs

This section of the report summarizes the light rail system costs.

Capital Costs: The cost of building the proposed light rail system has been estimated as follows:

	Original Alignment	Alternate Alignment
Total Capital Costs (1980 dollars)	$291.58 million	$294.05 million
Annualized Capital Costs	$ 23.67 million	$ 23.87 million
Cost per Mile	$ 13.25 million	$ 13.55 million
Annualized Capital Cost per Passenger	$ 2.08	$ 1.94

It is important to note that the cost of constructing a light rail system is increasing each day because of inflation. When the system is actually constructed, the total capital cost will definitely exceed $291.5 million for the original alignment or $294.05 million for the alternate alignment. In fact, assuming a mid-point construction period of mid 1990, the total capital costs could be around $755 million for the original alignment and $761 million for the alternate alignment, based on a 10-percent annual inflation rate in construction costs. Delays in implementing the project are therefore very costly. For example, shortening the construction period one year, to a mid-point in 1989 could save as much as $67 million.

To help put these costs in perspective, it might be good to make some comparisons with Bi-State's current capital improvement program, just for maintaining and expanding the all-bus program.

For the fiscal years 1980 - 1984, Bi-State anticipates expending a total (local and federal) of $201.8 million, an average of $40.4 million annually. The light rail system, assuming a 12-year program to completion would cost in the neighborhood of $63 million annually. While this is greater than the capital costs programmed for the bus system, the expenditure of funds to construct the light rail system would help bring about greater operating cost efficiency in the future. Thus, it is an investment to be paid back from future operating cost savings.

Operating Costs: The costs of operating the proposed 22-mile light rail system are as follows:

Estimated 1980 Operating Costs	$2.39 million
Estimated 1985 Operating Costs	$3.85 million
Estimated 1995 Operating Costs	$10.00 million
Cost/Passenger (1980)	$0.39/$0.36
Cost/Passenger (1985)	$0.49/$0.45
Cost/Passenger (1995)	$0.88/$0.81
Cost/Vehicle-Mile (1980)	$2.06
Cost/Vehicle-Mile (1985)	$3.32
Cost/Vehicle-Mile (1990)	$8.62

Note that the operating costs were projected to increase 10 percent annually.

The estimated unit cost of around $0.39 per passenger suggests that the light rail system would be very cost-efficient when compared with an all-bus system. Overall Bi-State reported a unit operating cost figure of $0.91 per passenger in 1979. Moreover,

this unit cost figure has been increasing at an annual rate of 12.8 percent since 1974. The savings in operating costs are obvious. Furthermore, after the initial construction and vehicle costs, the incremental cost of adding one or two cars per train is very small when compared to the increases in system capacity.

Bi-State's fiscal year 1980 operating budget is approximately $78 million. Estimated annual ridership for fiscal year 1980 is about 76.3 million, or $1.02 per passenger. 1980 estimated light rail figures, as compared to these are shown below:

Fiscal Year 1980	Bi-State System Estimates	Light Rail System Estimates
Operating Cost	$78.1 million	$2.39 million
Percent	97.0	3.0
Passengers	76.3 million	6.1/6.6 million
Percent	92.6/92.0	7.4/8.0

Summary of Benefits

Listed below in summary form are some of the more significant benefits to be derived from the construction of a light rail system in the St. Louis region.

Improved Transportation: A light rail system, properly designed, can significantly improve the accessibility of the St. Louis CBD and other activity centers. Moreover, a light rail transit system would produce more cost-effective service and lower operating cost per passenger. The system would have greater capacity, higher speeds, greater reliability, and a more comfortable ride than a bus transit system.

Economic Development: Light rail stations would have the potential for encouraging development and redevelopment in certain areas. This added development could help produce increased tax revenues plus needed revenues to help offset light rail costs. The construction of the light rail system itself can have a significant impact on the local economy. It has been estimated that the construction alone would generate around 800 new jobs locally equating to around 2,100 man/years of work.

Image: In addition to the quantifiable benefits, the light rail system could also help improve the image of the St. Louis region. It certainly helps strengthen the image of the St. Louis and East St. Louis CBD's and helps reinforce downtown St. Louis as the point of regional focus. A modern, fast, light rail system alone can not produce magic, but if can, when combined with other projects and local initiative, create significant improvements in the total urban environment.

FINANCIAL PLAN

This report suggests one possible method of financing the proposed St. Louis Light Rail System. However, it should be noted that there are many possible methods of financing such a project. Therefore, the report also discusses alternate sources of revenues.

Moreover, to help highlight alternate financial methods, the report discusses several new light rail systems now under development.

Current Light Rail Transit Programs

San Diego: Perhaps one of the more interesting and unique of the current list of new light rail systems is the San Diego Trolley Project, see Figure 32. Figures 33 and 34 are Fact Sheets published by the Metropolitan Transit Development Board (MTDB), which is responsible for implementing and operating the light rail system. Incidentally, San Diego also has a publicly owned transit system, called San Diego Transit which owns and operates a bus system.

The San Diego system is a 15.9-mile system operating over tracks previously owned by the San Diego and Arizona Eastern Railway Company. In fact, the MTDB acquired the railroad company and also furnished freight service along 108 miles of track. Current estimates show that the system, when complete, will cost $86 million, or $5.4 million per mile. The low cost can primarily be attributed to the use of existing railroad tracks and facilities at a relatively low cost, the extensive use of single track, and the attempt to minimize costs in station and vehicle design. The system is a simple and basic system with no frills. Patronage

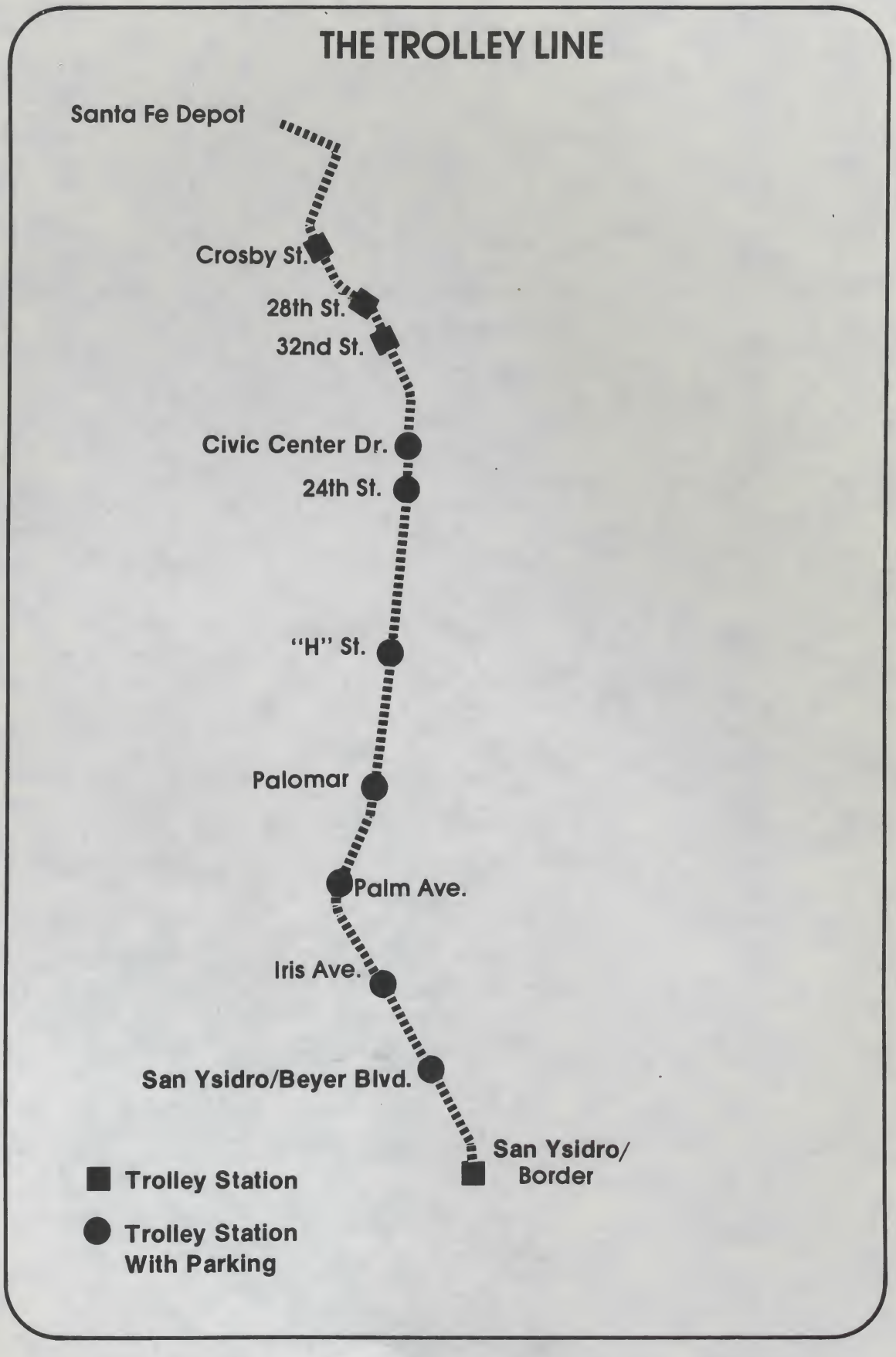
THE TROLLEY LINE
Santa Fe Depot
Crosby St.
28th St.
32nd St.
Civic Center Dr.
24th St.
"H" St.
Palomar
Palm Ave.
Iris Ave.
San Ysidro/Beyer Blvd.
San Ysidro/
Border
Trolley Station
Trolley Station
With Parking

Figure 32

mtdb

Figure 33

Fact Sheet No. 15

SAN DIEGO TROLLEY PROJECT CURRENT STATUS AS OF OCTOBER, 1980

SUMMARY STATUS

Development Schedule	As of October, 1980, the Trolley project is in the 22nd month of a 30-month development schedule. To date the project is on-time, with system opening slated for mid-1981.
Budget	100% of total $86 million (includes Prop. 5/SCA 15 interest payback) in development costs is already under contract. About $1.4 million remains in design/construction contingency. Project is being carried out within budget.

RECENT KEY EVENTS

New Track in Centre City	Installation of new track began on 12th Avenue during April and on C Street during June. Underground utilities relocation virtually complete.
San Diego and Arizona Eastern Railway Rehabilitation	Work to upgrade the SD & AE between Centre City and San Ysidro is complete as of September, 1980. Work going on now is related to double-tracking the line.

CURRENT CONTRACT STATUS

Trolley Vehicles	First of 14 cars delivered to San Diego in August, 1980.
Self-Service Fare Collection Equipment	Contract for $620,200 awarded on 10/15/79 for ticket vending machines.
Centre City Construction	Contract for $3.7 million awarded on 12/26/79 for new track in Centre City. Work began January, 1980; scheduled for completion November, 1980.
Railway Rehabilitation	Contract for $4.9 million awarded 12/26/79 for upgrading SD & AE. Work began January, 1980.
Maintenance/Operations Facility	Contract for about $1 million awarded in early April, 1980.
Stations/Parking Lots	Contract for about $3.7 million awarded in mid-September, 1980.
Other Contracts	MTDB has also awarded contracts for traction power, traffic signals, and railroad signaling and control.

UPCOMING EVENTS

Vehicle/System Testing	Planned to begin in fall, 1980 along a two-mile stretch of test track on the SD & AE between 32nd Street and Civic Center Drive in National City.

OTHER ACTIVITIES

East/West Extensions Analysis	MTDB is considering using SD & AE Railway for Trolley service to Southeast San Diego, Lemon Grove, La Mesa, El Cajon and Santee.
Operations Readiness	MTDB has engaged a team of rail operations consultants to help start up operations. Team is assisting in organization, management procedures, and recruitment of operational and technical personnel.
Safety Education	Program underway to promote railway safety of students, residents, employees along Trolley route.
Public Information/Marketing	Program underway to promote transit use; educate riders on how to use; simplify use of all public transportation services in metropolitan area.

October, 1980

Figure 34

mtdb
Metropolitan Transit Development Board
620 "C" Street, Suite 400, San Diego, California 92101 (714) 231-1466

SAN DIEGO LIGHT-RAIL TRANSIT PROJECT
CENTRE CITY PORTION
FACT SHEET

ROUTE CHARACTERISTICS

Centre City Limits — From Santa Fe Depot (at Broadway & Kettner), east along C Street for 17 blocks, to 12th Avenue; then south along 12th Avenue for 9 blocks to National Avenue. Jogs left to 13th Street, thence to existing right-of-way of San Diego & Arizona Eastern Railway yard

Distance — 1.7 miles (2.7 km) ..... In Centre City area

Total Route — 15.9 miles (25.2 km). LRT line will connect Centre City with International Border at San Ysidro; 11 passenger stations provided outside Centre City

OPERATING PLAN

Characteristics — At-grade, double track, on exclusive path mostly in center of city streets

Frequency — Peak Period and Midday ..... 15 minute headways

LRT Vehicles — Electrically-propelled articulated vehicles; in trains of two cars; wheelchair accessible

Average Speed — 9 mph (14.3 km/hr) ..... In city streets

Traffic Circulation — Auto traffic running parallel to LRT trains will be permitted. Left turns across tracks will not be allowed. Cross street will remain open. Emergency and delivery vehicles will be accommodated. Traffic signals will be timed to allow smooth-flowing traffic

Parking/Loading — Some on-street parking will be removed. Some loading bays will be provided on C Street and 12th Avenue

ACCESS

Stops — C Street ..... Every 3-4 blocks; total of 6 stops
12th Avenue ..... Every 3-5 blocks; total of 3 stops
Stops made in zones protected from bypassing traffic

Fare Collection System — Self-service, barrier-free; spot ticket checks on-board LRT vehicles. At least one ticket machine installed at each stop along C Street and 12th Avenue

FINANCIAL & CONSTRUCTION PROGRAMS

Costs — About $5.4 million ..... Centre City project development cost
$86 million (Including Interest Payback) ..... Total 16-mile route

Development — Centre City work begins January, 1980 and ends November, 1980. Construction to be staged in short increments of several blocks

System Opening — Total 16-mile line to open mid-1981

AMENITIES & IMPROVEMENTS

Poles — Poles to support overhead wires on C Street will be new, slim, brown metal, complementing existing urban design. Poles to support sodium vapor lights for improved visibility and safety
Poles on 12th Avenue will be natural-looking wood and will replace existing utility poles

Underground Utilities — As track is laid along city streets, concurrent work will be done, in cooperation with City of San Diego, to replace some old underground utilities

Location — Location along C Street will take advantage of existing urban design amenities and landscaping

FUTURE CENTRE CITY PLANS

Transit Way — A portion of C Street ultimately is planned as a transit pedestrian way

Convention Center — The LRT route at the west end of C Street will fit with plans for a new convention center and hotels

Member Agencies: City of Chula Vista, City of El Cajon, City of Imperial Beach, City of La Mesa
City of Lemon Grove, City of National City, City of San Diego, County of San Diego, State of California

October, 1979
For more information, contact MTDB at address

estimates for 1995 run around 30,000, with peak hour service every fifteen minutes.

The system's capital costs are being funded through two primary funding sources:

1. California's Urban Guideway Program
2. California Sales Tax on Gasoline

Interestingly, the system has not, to date, utilized any federal or UMTA funds to cover capital expenditures.

Denver: Denver is planning a 73-mile system, the first fifteen of which would have to be in operation by 1985 for funding to continue. This initial segment would begin in downtown Denver, and follow the alignment of the Denver and Rio Grande Western Railroad generally south to the vicinity of Broadway and Interstate 25, then generally east on the right-of-way line of Interstate 25 to the vicinity of Arapahoe Road. Two branches are planned, provided construction can be coordinated so that construction on the branches does not delay opening of the main section. The entire 73-mile system is expected to cost $930 million in 1980 dollars, or approximately $12.7 million per mile. The system was to be financed locally through a 3/4 percent sales tax to be authorized for seventeen years. However, this tax legislation was defeated in a November public referendum, and planners are now reworking the financial plan. At this point no federal money has been requested.

Edmonton: Edmonton has a 4.5-mile segment leading northeast from downtown, utilizing a downtown tunnel and existing Canadian National Railway rights-of-way, which has been operating successfully since April 1978. This existing section cost $65 million, or

$14 million per mile. The city is now considering a 14.2-mile line in the South Corridor, estimated at $284 million, or $15 million per mile. The funds come from a "Heritage Trust Fund" created by the Alberta government in 1974 with "windfall" revenues generated by the rapid, OPEC-fueled increase in Alberta's energy revenues. By 1978 the fund had accumulated $3 billion, and was projected to reach $10 billion by the mid-1980's. Peak hour trains run every five minutes, and are expected to run every five to ten minutes on the new line.

Calgary: Calgary's 8.2-mile system is projected to cost $144 million, or about $18 million per mile. Although similar to Edmonton's system, several years of delay drove Calgary's system costs up approximately $4 million per mile. Trains will run about every 4.5 minutes, carrying 15,000 passengers in peak hour. Calgary's system, like Edmonton's will be funded from the "Heritage Trust Fund" established by the Alberta government from the province's energy income.

Portland: Portland plans a 15-mile system connecting downtown Portland with downtown Gresham. In downtown Portland the light rail cars will operate in reserved lanes on First Avenue, Morrison, and Yamhill Streets, then cross the Willamette River in the middle lanes of the Steel Bridge, and continue along Holladay Street to the Coliseum and Lloyd Center. From there the tracks will be located between the Banfield Freeway and the Union Pacific tracks. At East Burnside Street, the line returns to street operation in the center lanes of East Burnside. East of 200th Avenue, the track will leave East Burnside Street and parallel Portland Traction

Company freight tracks to a terminal station at 8th and Cleveland in Gresham. The entire project is billed at $102.5 million, or about $7 million per mile. Funding comes primarily from Oregon highway funds and from the federal government.

Revenue Sources

Financing transit operations represents a major challenge to any community. Some communities have developed innovative financing mechanisms. Others have utilized the more traditional methods. Listed below are some of the most common local sources of revenues for financing transit operations; federal operating and capital funding programs are not included.

State Support: Here state support is defined as revenue allocated from normal state revenue sources such as the personal income tax, motor vehicle fees, or some excise taxes. Some states, such as Maryland and Louisiana, contribute significant levels of state support to cover either capital or operating expenses.

Property Taxes: Property taxes have long been the primary source of income to local governments. They are also used in some areas to help support transit operations. For example, four counties in the San Francisco area support transit from this source, either through municipal general funds, or through special purpose district taxation.

Benefit Assessment Districts: A transit benefit assessment district would be similar to existing sewer, water, and other "benefit" districts. The purpose of such districts is to recoup part or all of the costs of public improvements from those areas which tend to benefit the most. Benefit assessment districts could be created

around transit stations to help pay for the initial cost of station improvements or to help offset operating costs. A number of related, but different concepts should be utilized including joint power agreements, tax increment financing, transfer of development rights and the single land tax.

Income Tax: Largely a state revenue source, and by far, the largest source of funds for the federal government, the income tax could be used to support transit operations.

Fuel Tax (Excise and Sales): Either a flat rate per gallon, or a percentage rate could be employed to support transit. This funding source has normally been reserved for highway purposes, but has been diverted to mass transit in some areassuch as California and Chicago.

Motor Vehicle Charges: State charges on motor vehicle registration and licenses could be increased to provide some support for mass transit. Again these funds have often been dedicated to highway purposes, including enforcement.

Parking Charges: Some communities have considered using revenues collected from a tax on parking revenues for transit. Again, the tax could be either in the form of a rate charged per hour or in the form of an overall percentage rate. To date no local government has actually imposed such a tax for transit support, even though higher parking costs would tend to discourage personal automobile use and encourage greater transit usage.

Bridge Tolls: Tolls on vehicular travel crossing bridges have been used to support transit. This could be either in the

form of a surcharge or the allocation of a specified portion of the toll receipts on bridges which have excess revenues.

Excise Tax: An incremental excise tax on such items as cigarettes and alcoholic beverages currently provides revenue to general funds at both state and local levels. Neither source is used for transportation at the present time.

Lottery: Pennsylvania currently assists a number of its transit systems with revenue generated by the state lottery.

Recommended Plan for St. Louis

Proposed Construction Phasing (Phase A): The entire 22-mile light rail system can not, because of financial constraints, be constructed without some type of phased implementation schedule. Additional studies and an environmental impact statement will be required before any final implementation schedule can be developed. However, the results of this study, including an analysis of financial resources, suggest that the initial light rail segment should consist of the 12-mile segment from East St. Louis to Natural Bridge Road (UMSL). This segment generates the greatest patronage and serves numerous major generators, such as UMSL, downtown St. Louis, and the Kingshighway medical complex. Extensions to this segment could be constructed in the future as financing becomes available. These extensions might include a line to Clayton or an extension to the airport.

Figure 35 illustrates a recommended implementation schedule for Phase A, which shows completion and start of operations in

Figure 35

RECOMMENDED PHASE A IMPLEMENTATION SCHEDULE

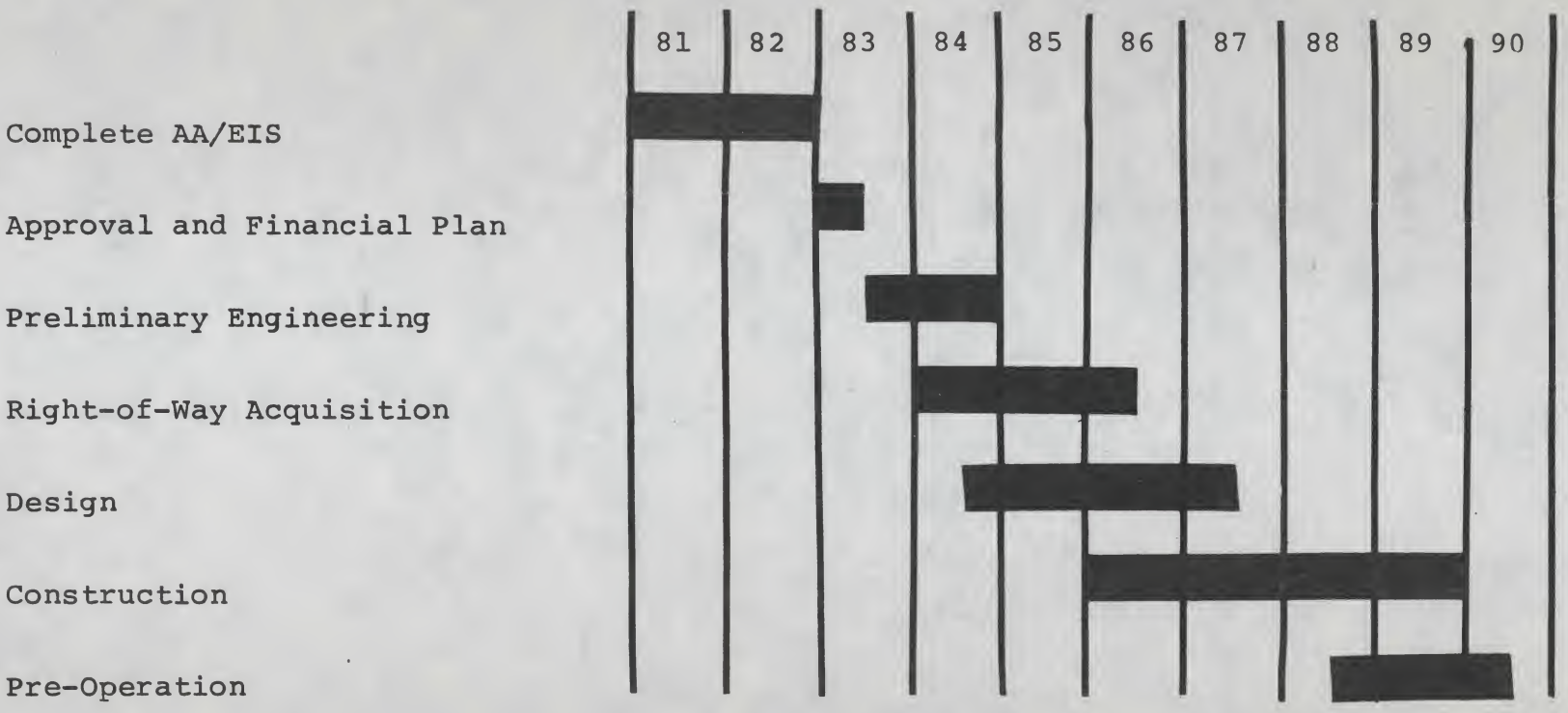

TABLE 14

ESTIMATED PHASE "A" COSTS

Item	Estimated Cost Future ($ millions)	Current ($ millions)
Construction ('87)	$253.48	$129.99
Right-of-Way ('85)	1.87	1.16
Yards & Shops ('87)	23.34	11.97
Park-and-Ride Facilities ('87)	5.05	2.59
Vehicles (12) ('87)	18.02	9.24
TOTAL	$301.76	$154.95

Table 15

BI-STATE LOCAL FUNDING

Fiscal Year	Missouri ½-Cent Sales Tax Receipts: City of St. Louis ($ millions)	Missouri ½-Cent Sales Tax Receipts: St. Louis County ($ millions)	Illinois ($ millions)	Total ($ millions)
1974	6.2	11.5	--	17.7
1975	8.8	16.9	3.4	29.1
1976	8.9	18.9	3.6	31.4
1977	9.7	21.7	4.0	35.4
1978	10.6	24.7	4.4	39.7
1979	11.6	27.4	5.1	44.1
TOTAL	55.8	121.1	20.5	197.4

Local funding in Illinois is currently in a state of uncertainty. The State of Illinois is requiring Illinois counties to participate in funding the local share. At present, no complete local funding program has been developed, meaning that transit service in Illinois may have to be reduced significantly.

Estimated Phase A Revenues

In order to finance the full 12-mile Phase A segment by 1990, several sources of revenues were explored. In the final analysis the following revenue sources are recommended:

Unappropriated Missouri Sales Tax Funds: At present, both the City and County of St. Louis have slightly over $19 million in funds which were collected from the ½-cent sales tax, but which have not been appropriated for Bi-State. Some of this money has been used for other purposes. To initiate construction on the light rail program, it is proposed that around $15 million of this money be appropriated for light rail design, construction, and right-of-way acquisition. These initial funds would allow the program to proceed, help reduce inflation costs, and generate approximately $75 million in federal funds.

Missouri Sales Tax: It is recommended that the Missouri ½-cent sales tax be increased to a 1-cent tax by 1983, with a total of five percent of the sales tax revenues earmarked for light rail. Listed below are the projected sales tax revenues (1-cent tax) and the five percent earmarked for light rail.

	Missouri Sales Tax ($ millions)	5% for Light Rail ($ millions)
1983	$85.8	$4.3
1984	89.4	4.5
1985	93.4	4.7
1986	97.4	4.9
1987	101.8	5.1
1988	106.4	5.3
1989	111.0	5.5
1990	116.2	5.8

The sales tax revenues are based on a conservative estimated using an annual growth rate of 3 percent for the City of St. Louis and 5 percent for St. Louis County. Histroically sales tax revenues have increased at a faster rate, except for recent years which were affected by the recession and slow economic growth.

Illinois Local Share: Continued support from the State of Illinois and St. Clair County is essential if the light rail system is to go into East St. Louis or beyond. It is anticipated, despite current uncertainties, that local funding will be made available from Illinois.

UMTA Capital Funds: A necessary revenue source for light rail is the 80 percent UMTA Capital Grant Program, Section 5. It is anticipated that this program will be continued and funded at increasing levels. However, there are no guarantees that these funds will be available when needed. Congress is currently debating funding levels for the next few years.

Table 16 shows the total estimated revenues required for completion of Phase A by the year 1990. Note that over $241 million, 80 percent, is expected to come from federal UMTA capital grants, Since St. Louis is in competition with many other cities for these funds, it is important that the light rail program proceed at a rapid pace with continued public support. Without public support and a completed and acceptable program, UMTA funds will continue to be directed to other cities, not to St. Louis.

TABLE 16

ESTIMATED PHASE A REVENUES

1980 - 1990

Unappropriated Missouri Sales Tax Funds	$ 15.06 million
1984 - 1989 Missouri Sales Tax Funds	$ 40.10 million
Illinois Local Share	$ 5.19 million
Total Local Funds	$ 60.35 million
UMTA Capital Funds	$241.41 million
TOTAL ESTIMATED REVENUE	$301.76 million